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THE HUDSON RIVER TUNNEL—NEW YORK END.

The work of excavating the railway tunnel under the Hudson River between New York and Jersey City is going on rapidly and successfully. The working on the Jersey side proceeds in the manner heretofore described and illustrated in this paper, both headings of the (double) tunnel having been advanced two or three hundred feet since our last mention of the work. The headings are now about eight hundred feet from the entrance, the material to be pierced remaining the same—a more or less tenacious river silt.

The sinking of the caisson on the New York side, at the foot of Morton street, is progressing satisfactorily. The caisson is now down nearly to its final position, the mode of working presenting no strikingly novel features, though there have been some changes in details, to adapt the processes employed on the other side of the river to the different material encountered here. On the Jersey side the earth, as our readers know, is a compact clay. On this side of the river the caisson has to be sunk through sand and gravel carrying small bowlders. The clay is puddled to a creamy consistency and forced to the surface by the pressure of air maintained in the tunnels. The sand, on the contrary, is blown out dry, the coarser gravel and stones being hoisted out in buckets by a method to be described further on.

A view of the outside of the caisson and its surroundings is shown in Fig. 1. The plan of the caisson is shown in Fig. 4. It will be seen that this structure differs from the one used across the river, in that it is substantially a box with sloping sides, instead of being arched in form; and the roof, which is strongly braced, carries a cribwork forty-four feet high, heavily weighted with brick to counteract the air pressure in the caisson.

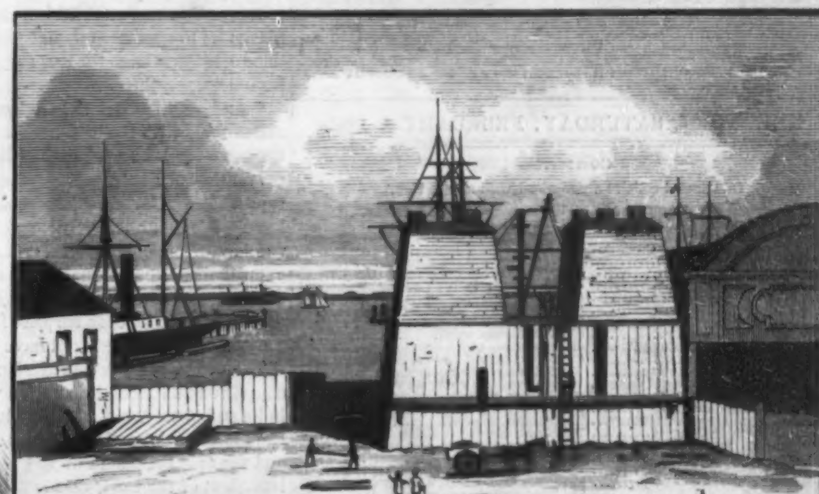
The dimensions of the caisson are: Bottom, 48 feet by 29 feet 6 inches; top, 46 feet by 27 feet 6 inches; height, 26 feet. The interior space, 23 feet high, is divided by a floor, as shown in Fig. 2. The excavation is made in the lower space, the mixed sand and gravel being shoveled to the foot of the pipe shown on the left. The rush of air up the pipe carries all the finer material. The coarser stuff is raised to the floor above, shoveled into the cylindrical receptacle shown in the engraving, and then raised to the surface through a shaft at the top.

When the door leading into the caisson is open the air pressure keeps the door to the shaft firmly closed. When a sufficient amount of gravel and stones has been shoveled in, the door (before which the workman stands in Fig. 2) is closed, and the excess of air in the lock is allowed to escape through a valve into the shaft. When the pressure is reduced to that of the outer air the shaft door opens, and the workmen proceed to hoist in buckets the material to be removed. This coarse material is used to fill in the cribwork over the caisson.

At the head of the ladder, in the upper right-hand corner of Fig. 2, is the passage to the air lock used by the workmen. This lock is the one used on the Jersey side before the bulkheads were built in the tunnels, as illustrated in this paper some months ago. The entrance to the air lock is shown in Fig. 3.

The working is carried on under an air pressure of 22 pounds. The caisson is lighted by electric lamps, as the tunnels are at the other side of the river. Speaking of the conditions under which the work is carried on, the Engineer in charge, General Sooy Smith, lately said: "It is high time that this enterprise should be understood by the public as being no more in the realms of experiment. Although we have been working on somewhat novel methods, we have sufficiently tested them to be assured of their success. The work is now as safely done as is possible for any subaqueous structure. We have the largest wooden caisson ever used and it cost less money. We have long since demonstrated the practicability of the work, and can no longer be taken by surprise in any difficulty."

At the bottom of our illustration is a sectional drawing of the river and its bed, showing the line of the tunnel and the progress made; also the nature of the material to be encountered. As the greatest depth of the river is near the New York shore, the grade at this end is steep.



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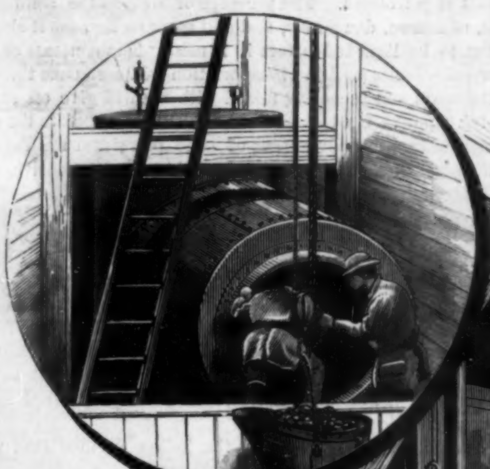

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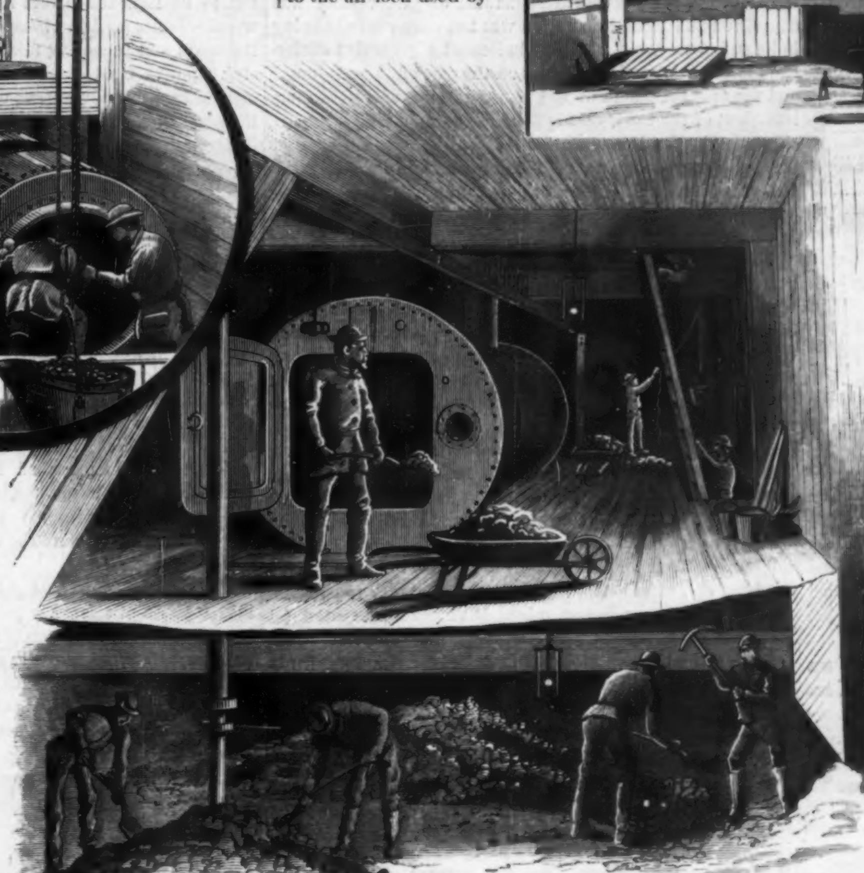

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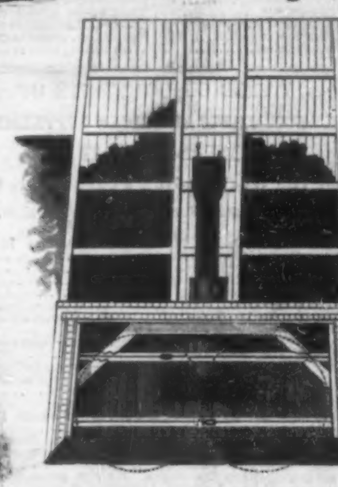

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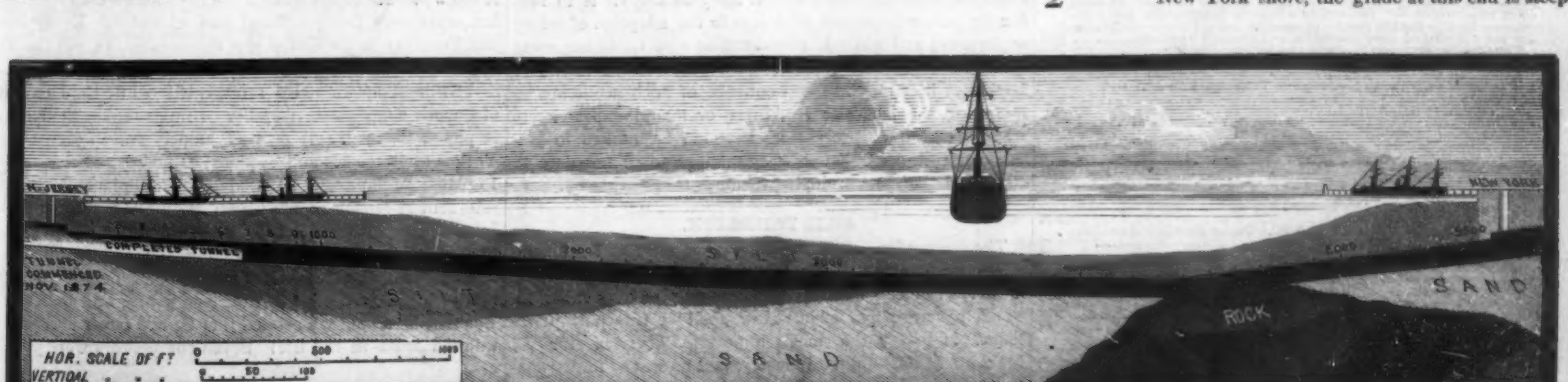

PROGRESS OF THE HUDSON RIVER TUNNEL.—THE NEW YORK CAISSON.

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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT,

No. 818,

For the Week ending February 4, 1882.

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CRIMINAL NEGLECT IN RAILWAY MANAGEMENT.

On the evening of January 13, an Albany express train on the Hudson River Railroad, drawn by two locomotives and bound for New York, was stopped by an accidental or unauthorized application of the air brakes just after the train had passed a sharp curve and a deep rock cut near Spuyten Duyvil Station, at the upper end of New York Island. The rear of the arrested train was shortly after run into by a regular train known as a Tarrytown special, also bound for New York. The rear car of the express train was wrecked by the collision and quickly fired by an overturned stove. Several passengers were instantly killed, and others, caught and held by wreckage, were suffocated or burned alive. In all eight lives were lost, including that of Senator Wagner, inventor of the drawing room cars which go by his name.

A very careful investigation of the conditions and causes of the disaster was made by a coroner's jury, largely composed of civil and mechanical engineers, resulting in a verdict which is quite exceptional in its sweeping condemnation of the conduct of the trainmen and the managers of the road, who were individually held responsible for the loss of life through their criminal neglect of duty.

Specially remarkable and encouraging are the findings of the jury relative to the culpability of the superintendent of the road and the officers of the New York Central and Hudson River Railroad Company: the former in neglecting to provide efficient safeguards against accident at a peculiarly dangerous part of the road; the latter in neglecting to provide suitable implements for the rescue of passengers in danger, and proper means for extinguishing fires on the trains, and in not establishing the competency of their employes by proper mental and physical examinations to test their qualifications for the responsible and critical duties imposed upon them.

"And, as a further expression of their opinion, the jury affirm that, with the experience of fifty years of railroad management, and with the appliances in general use for the prevention of like disasters, there appears to be no palliation whatever for the criminal carelessness and disregard for human life exhibited by the employes of the company. The conduct of these employes removed this calamity from the chapter of accidents, making the result of destructive agencies at work as much a certainty as the discharge of a piece of artillery. The only surprise is that the slaughter was not greater. It could not well have been less."

The evidence by which the justness of this verdict was supported and made imperative was not only overwhelming in its sufficiency, but it clearly indicated a general indifference to the safety of passengers on the part of the conductor and the rear brakeman of the express train, and the superintendent of the road, that is little less than appalling.

It remains to be seen whether the action of the grand jury and the courts in criminal proceedings against the guilty parties will be such as to discourage similar misconduct and neglect of duty by railway officials and servants in the future.

The safety of the arrested train in an unusually dangerous position devolved upon a train man who could not read, and who testified that, out of forty-five or fifty similar stoppages of the train while he had been rear man, he had gone back to flag following trains not more than four or five times, and then without instruction from the conductor of the train. This time he did not go back, and the disaster was an immediate result.

After the collision the loss of several lives might have been prevented had the train carried water buckets or other means of extinguishing fire, or axes to enable those unhurt to open the side of the burning car and release those who were wounded or caught in the wreckage. Or the fire itself might have been prevented had the heating apparatus of the car been of a safer sort. Still better, all liability to collision under such circumstances might have been prevented (at least not left to the hazard of an incompetent and negligent trainman) by the use of inventions well known to railway managers, or which would be well known were it not their deliberate policy to refuse to consider patented inventions (the use of which would involve payment of royalty to the patentees) unless personally interested in the patents.

It is too much to expect that the action of the courts in this case will be such as to convince railway managers and superintendents of the impolicy of the course they now pursue with respect to inventions designed solely to increase the safety of passengers. But one natural effect of easily avoidable slaughters like that at Spuyten Duyvil is to render the public impatient of delays in the adoption of safety appliances; and while it would not be wise to dictate what specific devices shall or shall not be used on the railways, laws may be passed, in consequence of such accidents, so increasing the penalties for killing or maiming passengers where well known precautions have not been taken to prevent such disaster, that railway managers will not dare to run the risk of not employing them.

SOLID PETROLEUM.

The conversion of petroleum into a solid and safe substance for transportation seems to be attracting considerable attention in foreign countries where no pipe lines exist. A St. Petersburg paper says: How shall we transport petroleum? is to-day the most important question for all branches of the naphtha industry, and no less so for the consumers who live at a distance from the wells. All the methods of transporting petroleum hitherto in use, whether in wooden or paper barrels, in iron pipes, or iron caissons that are placed on ships or cars, possess disadvantages which are sufficiently well known, especially as regards leakage and evaporation, and also the great danger from fire.

These misfortunes which afflict so severely both dealers and consumers and increase the cost of an article of such importance in domestic economy, have been banished at a single stroke by the discovery of a German named Dittmar, who has succeeded in converting liquid petroleum into a solid substance. As early as 1872 the idea arose in America of solidifying petroleum so as to put it into a more suitable form for transportation, and in that year no less than twelve patents were taken out for this object without any single one of them being found practical. What a range such a discovery would cover, as would change petroleum into a solid wax-like body, can scarcely be conceived of, especially for the Caucasian naphtha industry, where there is a lack of suitable wood for making the barrels, which has a very serious effect upon the industry. The Moscow *Zeitung* also contains a thorough discussion of the new invention.

Solid petroleum has not yet come into market because the patents have not yet been issued, but a company has been formed in Russia for carrying out the invention. The cost of conversion is not to cost over six kopecs per pud, while the barrels, which will then be superfluous, increase the price of petroleum by 55 kopecs, but the leakage, which would no longer take place, is included in this. It may be added that solid petroleum can be readily converted into the fluid form for pouring into lamps.

To this and other remarks that have appeared in the technical journals the Russian *Pharmaceutical Zeitschrift* adds the following explanations from the pen of E. Johanson. He found that petroleum when heated would take up a certain quantity of dry soap, and that the solution on cooling would form a jelly, which when ignited drops off in pieces that soon go out like burning sealing wax. Dilute acids, like acetic acid, restore the fluid condition (evidently owing to a decomposition of the soap). In this way he explains all that has been asserted and claimed for the solid petroleum.

Only one and a half per cent of soap is required to form a gelatinous mass like opodeldoc, but with three per cent of soap it is much more firm. In this operation there separates a small quantity of liquid products that do not become solid, and which probably consist of the lower boiling constituents of petroleum. The presence of these in the solid mass is, of course, dangerous, and still more so because it always has to be liquefied before it is used. The contents of the wooden boxes used in transportation will soon ooze through the wood and becoming mixed with air will give off explosive vapors. On this account the author comes to the conclusion that the advantages of solid petroleum are entirely imaginary, as being a tedious, troublesome, expensive, and dangerous operation.

THE STOCK CAR COMPETITION.

A pamphlet report of the "Doings of the American Humane Association," at its annual meeting last fall, gives in full the report of the judges on the $5,000 prize offered by the association for an improved cattle car. It will be found an interesting if not an instructive document to all who took an interest in the competition or retain an interest in the questions of humanity, health, and economy involved in the transportation of live stock.

It will be remembered that the judges decided that none of the designs offered in competition met the conditions of the award, and accordingly no prize was given. The money which had been subscribed for the purpose, with accrued interest, remains in the hands of trustees to be used in aiding the introduction of improved stock cars and in such other ways as may best secure the end desired by the subscribers to the fund.

The principal fact brought out by the competition and the investigation of cattle car patents that it called out, was that inventors had already pretty thoroughly covered the ground; in other words, when cattle suffer hunger, thirst, and other injury on the way to market it is not for lack of devices to prevent such injuries, but because the inventors of improved cars and appliances have not been able to get the railway companies to use them.

The report mentions a number of plans and models which were submitted for an opinion of their value, with a distinct provision that they were not in competition, their owners holding them at a higher figure than $5,000. Besides these 636 different competitors submitted 710 models and plans. A large portion of the models and drawings were very crude, but some were finely finished and executed. Every State and Territory in the Union was represented, except the Territories of Washington and New Mexico. England, Russia, and Switzerland were also represented, while the Dominion of Canada contributed liberally. Illinois sent 51 models and 18 plans; Pennsylvania sent 47 models and 27 plans; New York sent 43 models and 15 plans; Ohio sent 37 models and 18 plans; Indiana sent 21 models and 13 plans; Massachusetts sent 19 models and 26 plans; Michigan was the seventh, Iowa eighth, Missouri ninth, and Minnesota tenth in the number of contributions. Among the competitors were eight women, from the same number of States. One competitor was a young lad of fourteen years; and one model was sent by a man who stated that he had never even seen a railroad train in his life! Seven competitors were preachers.

To test the originality of the plans and models they had to be first compared with the descriptions and claims of the 111 patents upon stock cars and appliances granted since the

first stock car patent was issued to Lee Swearingen, May 29, 1860. All these patents were critically analyzed, and abstracts were made of their peculiarities. The improvements shown in them were chiefly on partitions or stalls; on feed troughs; on water reservoirs and water mains; on food bins and hay racks; on food lofts; on stanchions for securing the animals; on different methods of tying them; on double decks, for smaller animals; on sprinkling apparatus for keeping the animals cool, and a large number of minor devices. The list of the more important contrivances given in the judges' report indicates the thoroughness with which inventors had considered the problems involved, and suggests the thought that had the committee made these investigations before the prize was offered and published the results in their first circular, as an indication of work to be avoided, they would have saved the judges a vast amount of labor, and the competitors for the prize a vast amount of fruitless effort in reinventing what others had already patented. The same inventive effort more intelligently put forth might have yielded much more that would have been novel and useful.

Incidentally, we may remark that perhaps the chief source of disappointment and waste of time experienced by inventors may be found in their lack of knowledge of what previous inventors have done. Reinvention may be a good school for the young inventor, but it does not pay as a business. The proverbial "poor devil of an inventor" is usually a man who continually exercises his wits—sometimes very ingeniously—in working out problems already solved or proved insoluble. Such unsuccessful inventors almost always skip the first step in profitable invention, which is to find out exactly what needs to be done and whether the thing is worth doing.

The next work of the judges was to treat the competing plans as they had treated the pre-existing patents. It was soon found that the material to be dealt with contained comparatively few leading ideas, and these were in lines already well worked out. Many had peculiar, often ingenious arrangements, noticeable mainly for their impracticability. Lack of novelty, however, appears to have been the principal cause of failure to win the prize. A number of the non-competing devices would seem to have shown more positive elements of merit, especially those for improved methods of feed and watering. These the inventors were unwilling to part with for the amount of the prize. Of the rest the judges say:

"That after rejecting all designs which did not meet the conditions in other respects, and those which were manifestly impracticable, and those which consisted merely of old and well known devices, it was found that of the remainder there were absolutely none which had not been in some way shown, described, or covered in the patents already granted. There were very many ingenious devices presented (many of them, *of themselves*, patentable) and many designs which were undoubtedly new and original with the competitors who sent them to us; but the stubborn fact remained, that, behind them all were the broad, underlying claims of some patent or patents, redering it manifestly imprudent for the American Humane Association to purchase any one of them."

They add, "as their deliberate conviction, forced upon them against their will, that it is hardly possible for any inventor, no matter how skilled he may be, to invent a successful stock car, in which stock can be properly separated so that they can lie down and rest, and in which they can be fed and watered, while in motion, without such car infringing on some one or more of the patents granted previous to February 1, 1881, or even previous to January 1, 1881."

The competition, however, the judges think, was not without good results in drawing attention to the subject of the crying need of kinder treatment of live stock in transit. It remains to be seen whether public opinion will be strong enough to induce or compel the great stock-carrying companies to make use of existing appliances, which would appear to be sufficient to do away with most of the evils complained of by the association.

PLATING COTTON WITH SILK.

A method of depositing silk upon cotton or linen thread, not unlike that of electroplating iron or brass wire, has been devised by Hosemann and Ungenad. Instead of silk, wool or feather down may be deposited upon the thread, from an alkaline solution, without the aid of pressure or electricity. Thread prepared in this way not only looks like silk, wool, etc., but can be dyed, bleached, and dressed like real silk or wool. Silk can also be deposited upon silk, or wool upon wool, so as to improve the quality. Even colored silk, wool, or down can be deposited.

The silk solution is prepared, says the *Deutsche Industrie Zeitung*, by putting 2 or 3 pounds of silk waste and ravelings into 100 pounds of clear caustic soda or potash solution of about 36° Baumé. On warming the solution the silk rapidly dissolves. It is next diluted with more or less distilled water, according as a heavy or light layer of silk is to be deposited on the thread. In the first silk bath, in which the yarn or fiber that is to be treated is brought, it is advantageous to dissolve a little good tallow, then boil it up and stir well.

The wool solution is made in the same way. Stiffening like gelatine can be put into the bath at the same time. If colored wool or silk is dissolved it will be deposited in the same color, of a bright shade, upon the fiber, and thus color it too. After the material that is to be covered has been in the solution a certain length of time, it is taken out and dried, and these operations repeated several times, beginning with a strong solution, and each time using a weaker one. Finally the goods are left for two hours in a strong bath of sulphuric acid, being moved around in it, and then carefully rinsed out into water. The solutions may be used cold, lukewarm, or hot, according to the character of the fiber. If the operation is begun in a hot bath, a cooler one is used next, and lastly a cold one. Yarn and fabrics which have been covered with silk are afterwards pressed hot, beaten, stretched, etc., as is customary with silks, in order to bring out the gloss and luster.

By this process dull, lusterless, and low price silks can be greatly improved by treating them with a solution of handsomer silk of better luster. If silk is repeatedly treated with this solution of silk its weight can be considerably increased. The precipitated silk adheres firmly and permanently to all kinds of fibers. Fabrics or fibers of flax and cotton, when treated with the solution of wool, acquire the appearance, touch, and feel of carded wool, while China grass and hackled flax has the appearance of worsted.

A very peculiar effect can be obtained by treating it first with a solution of silk and then with wool solution or the reverse. In one case we get a silken surface dotted with dull spots of velvet, and in the other a velvety surface with silky glitter. By selecting suitable solutions of each the two can be mixed and applied together. Feathers and down can be dissolved and then precipitated together from the alkaline bath upon spun fibers and yarn just as silk and wool are. In these feather solutions the textile fibers become covered with small lamellæ and particles which give it the appearance of real feathers. The introduction of this method of converting cotton into wool would afford a new use for woolen shoddy. P. N.

MARINE ECONOMY.

In an article published in the *Journal of the Franklin Institute*, Chief Engineer Isherwood shows that the yacht-built steamer Dispatch, lately purchased for the United States Navy, has such proportions of hull that "no engine power was expended in overcoming the resistance of the water to displacement by the progress of the vessel. That is to say, the difference between the power exerted by the fore body of the vessel in raising the displaced water from the center of gravity of the greatest immersed transverse section of the vessel to the general water level, and the power exerted upon the after body of the vessel in the direction of its motion by the ascending column of water caused by the forward movement of the vessel, were sensibly equal."

It appears from the elaborate description of the Dispatch given in this article, that she is extremely sharp and has a long after body and two bilge keels. Her length is 174 feet, breadth 25½ feet; mean draught of water 12 feet, greatest immersed transverse section exclusive of bilge keels 186½ square feet, displacement 552¼ tons; total immersed or wetted surface 5,516 square feet. It will be observed that her length is equal to 6·82 times her breadth.

She has 100 square feet of grate, and 2,214 square feet of heating surface in her boilers which are of the internal furnace horizontal tubular type.

Her engines are condensing vertical and direct acting, having two cylinders 33½ inches diameter by 33 inches stroke of piston, fitted with link reversing gear and an independent adjustable slide cut-off valve. It will be observed that her cylinders were "square." The volume of steam required to fill the clearances and steam passages is 6·97 per centum of that which is required to fill the cylinders with the pistons in place. She has a four blade true screw, 11 feet diameter with a pitch of $19\frac{1}{10}$ feet.

The average performance of the Dispatch in the waters of the Potomac River and Chesapeake Bay under the conditions of ordinary practice, and embracing the whole of her steaming from November 8, 1880, to March 30, 1881, are given in a table, from which it appears that with steam at 49½ pounds per gauge, vacuum 25½ inches, cutting off at 0·112, about one-ninth of the stroke from the commencement, she made $9\frac{9}{10}$ knots per hour, her screw making $59\frac{1}{10}$ revolutions per minute, and losing 15 per centum of its speed in slip. This is the average for 358 hours' steaming in smooth water, when she displaced slightly more than the above first statement, viz., 559 tons, including bilge keels. The cost in fuel was 3·9882 pounds of anthracite per indicated horse power per hour. The speed of this fine model was not as great as one would be led to expect from the statement of Mr. Isherwood above quoted and his description; neither was it as great as at an official trial made with her in Chesapeake Bay, of four and a half hours in one direction, and then four and a half hours in the opposite direction in straight lines, to ascertain her maximum speed in smooth water and its cost in fuel. On this trial a speed of 10¾ knots was attained with cut-off at the same point and throttle wide open; cost in fuel about the same as in practice. The results of the trial as well as of her practical operations are rather disappointing, since she appears to be of such perfect proportions none could be more so, indicating that there is something wrong about her screw. Still, accurate and complete data from unbiased sources are very scarce and very valuable to the engineer.

Mr. Isherwood's remarks upon the results relate almost entirely to the great cost of the power in fuel, which reaches four pounds almost per horse power per hour.

"The cause," he says, "will be found, as might be expected, in the enormous cylinder refrigeration due to the work of expansion by steam of high initial pressure largely expanding, the point of cutting off being a little beyond one-ninth of the stroke of the pistons from the commencement. Under these circumstances, when saturated steam is used with simple engines having cylinders of very moderate dimensions, without steam jackets, as in the Dispatch, the cylinder condensation is excessive and entirely defeats the economy which might be obtained from the same measure of expansion employed with superheated steam in steam jacketed cylinders of large dimensions. In fact, saturated steam cut off at one-ninth of the stroke of the piston, in cylinders like those of the Dispatch, produces no greater economy than if it was used with very much less expansion."

It must be borne in mind, however, that although the steam was cut off at about one-ninth of the stroke, yet owing to the volume of nearly seven per centum of the whole cylinder volume of steam in the parts and clearances the steam was expanded only 5·88 times, as stated in the tables of data.

The great importance of cylinder condensation is shown by the following astonishing statement: "The results from the indicator diagrams show that during about the first ninth of the stroke of the pistons, about 57½ per centum of all the steam entering the cylinders was condensed by their surfaces; including, of course, the surfaces in the steam passages up to the valves."

This is somewhat less strange when, after some discussion, it is shown that "when the pistons reached the end of their stroke the steam supplied by the re-evaporation was sufficient to leave only 22 per centum of the quantity generated in the boilers condensed; so that a large portion of the expansion part of the indicator diagram was due to this re-evaporation."

It seems to be rather an important omission in discussing the grade of expansion that the item of ports and clearances is not given a more important place. Whatever effect this would have had on the above conclusions it certainly shows the important difference in this case between expanding the steam nine times due to cut-off without parts and clearances and a little less than six times when their contents are included.

It will appear perhaps that these cylinders, being very short, ought to be kept at a higher temperature than would obtain in larger and narrower ones, with the same piston speed, initial pressure, and grade of expansion, but it is also a fact that it is impracticable to reduce the value of the ports and clearances for short cylinders to the same ratio of the cylinder volume that is possible in longer ones, which is a very important consideration when discussing the matter of expansion.

A Fog Bow before Sunrise.

The phenomenon of the ordinary rainbow is familiar to every observer of nature. White fog bows, or "fog eaters," as they are called by the sailors, are frequently visible in localities favorable for their formation; and they are generally regarded as indications of clearing weather.

A fog bow was observed, writes Mr. H. C. Hovey, on the morning of the 8th of January, from my residence on Fair Haven Heights, near the estuary of the Quinnipiac River, and about 100 feet above the sea level. No rain was noticeable in any quarter, but the valleys were filled with fog, above which the hill tops stood like islands. At exactly ten minutes before sunrise (due at 7:26 A.M.), on looking northwest I saw a brilliant arch of prismatic colors spanning the East Rock Range, the highest point of which is 350 feet above the sea. As the sun arose the arch diminished in height and vividness, and by the time the orb was visible in the morning sky, the fog bow had vanished.

How the Aurora is Formed.

In a recent lecture by Professor W. Grylls Adams, recently published, the following theory is propounded to account for the observed interrelation of earth currents, magnetic storms, aurora and sun spots. Professor Adams assumes the sun to be a magnet, and infers that changes in his magnetism affect the magnetism of the earth. Further, the sun and moon, by dragging the atmosphere toward them as the earth revolves, may cause that friction between air and earth, and also that evaporation, which together may generate the supply of positive electricity in the air and negative in the earth. "Again," he says, "these tides in the atmosphere will cause the mass of it to lag behind the revolving solid earth, and at a height of thirty or forty miles we have a layer of air which, for air, is a comparatively good conductor of electricity. Here, then, we have, not a lagging of the magnet behind the conductor, but a lagging of the conductor behind the magnet, and hence, according to the laws of Faraday, we may expect a current or a gradual heaping up of electricity in the air in the opposite direction to the earth's crust." Thus, the regular tidal-waves in the atmosphere would cause the gradual transfer of positive electricity from the poles toward the equator, either as a current or a mass of air statically charged. "When the air is charged up to discharging point we may get the sudden discharges, such as the aurora, in the air and the earth current in the earth; and since the conducting layer of air approaches nearer to the earth in the colder polar regions, possibly within twenty miles of the earth's surface it may be found that the discharge of the aurora may even take place from earth to air by gradual, slow discharge, aided, as it may be, by the state of moisture of the air, and by change of temperature and other causes."

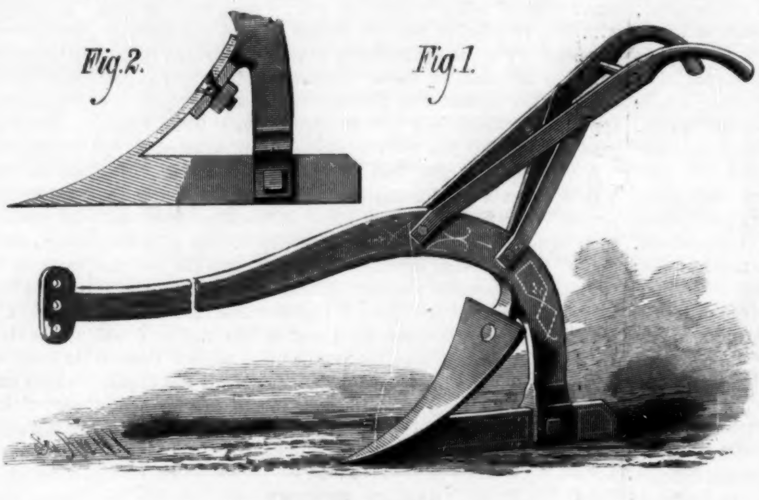
IMPROVED SHOVEL PLOW.

The engraving shows an improved shovel plow lately patented by Mr. George S. Agee, of Mint Hill, Osage County, Mo.

In this plow a horizontal bar or beam is welded or bolted to the lower part of the shovel, and is bolted to the end of the curved beam. The upper end of the shovel is secured to an arm of the plow beam by a bolt, as shown in the sectional view, Fig. 2.

The handles of the plow are made adjustable to suit persons of different height. The bar extending backward from the shovel insures great steadiness in the running of the plow. The forward end of the beam is widened and has three or more holes for receiving the clevis bolt. This arrangement permits of adjusting the plow at any required depth, and when so adjusted it will plow at a uniform depth.

All of the parts of this plow, with the exception of the handles, are made of iron or steel, and it is carefully designed with a view to strength, durability, ease of handling; and it is especially adapted to working in trashy ground, as it will not clog under any circumstances.



AGEE'S IMPROVED PLOW.

A Beautiful Grass.

From Mr. Andrew Curtis, Peabody, Mass., we have recently received specimens of a most beautiful and useful grass growing in Mr. Curtis' locality. It is the *Phalaris canariensis*, and is a native, as its name indicates, of the Canary Islands. It is closely related to the ribbon grass, or striped grass of our gardens, *Phalaris arundinacea*, which is a native of swamps. The specimens received from Mr. Curtis are about two feet high, with short, thick, beautiful heads, somewhat resembling the heads of some varieties of millet. Mr. Gould says of this grass, in the New York State Agricultural Report, 1869, that it produces the best known seed for the canary birds, and that from thirty to forty bushels may be produced per acre. Cattle are also very fond of the grass and hay, but the yield has not been usually so large as to attract much attention to it as a forage grass. It produces flowers, according to Mr. Flint's treatise on grasses, in July and August. It must be quite desirable for winter bouquets, as it is showy, and retains its color well.—*N. E. Farmer.*

IMPROVED WIRE FENCE.

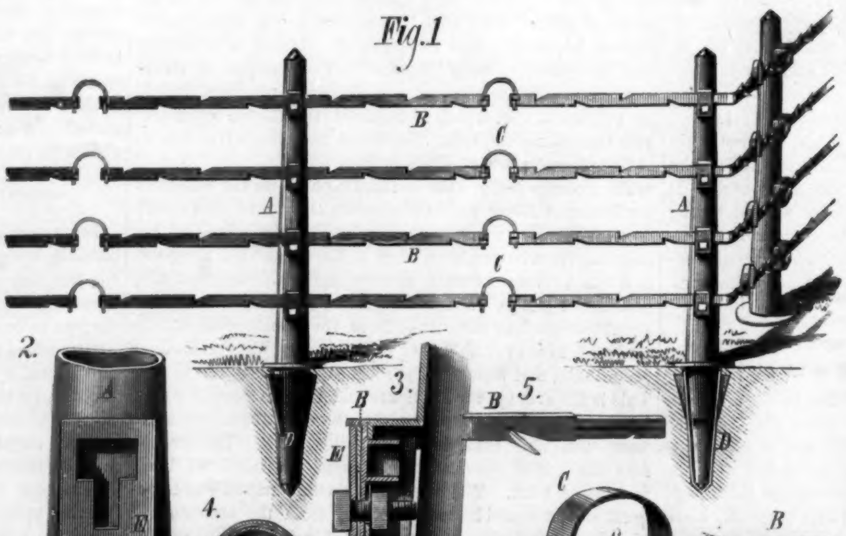
The engraving shows an improved wire fence lately patented by Mr. Edward Ruane, of Center Rutland, Rutland County, Vt. This fence is made entirely of metal, and is contrived so that it may be rapidly erected and will maintain its shape in all weathers and under all ordinary circumstances.

A general view of a portion of a fence of this kind is shown in Fig. 1. Figs. 2 and 3 show a portion of one of the posts with the locking device in section in Fig. 3. Fig. 4 is a horizontal section of the post. Fig. 5 shows the end of one of the wires or strips of which the fence panels are formed, and Fig. 6 shows the spring expansion joint and the manner of fastening the strips or wires.

The hollow cast iron posts, A, are provided with as many hollow projections, E, as there are strands or wires in the fence. These projections are provided with bolt slots large enough at the upper end to receive the nuts of the small bolts, and small enough at the lower end to receive only the body of the bolt. The fastening of the wire consists of two small plates embracing the wire or strip and clamped against the projection, E, by the small bolt. One of the plates has a small flange formed on its upper edge to protect the joint.

The strips, B, of which the fence panels are formed are of steel, with barbs formed upon the upper and lower edges by cutting diagonally into the edge and bending the pointed piece outward, so as to stand at nearly a right angle with the strip. The ends of the strips, B, are split for a short distance, and may be bent to attach them to a post or to the curved springs, C, as shown in Fig. 6. These springs compensate for the expansion and contraction of the strips, and while they always keep the strips straight and taut they prevent any undue strain from coming on the wires or posts. The bottoms of the posts are of two kinds, one in the form of a cone with wings, as shown in the engraving; the other is provided with a removable socket, into which the lower end of the post is inserted and locked by a species of bayonet joint.

This fence may be cheaply made, is easily erected, and possesses the quality of durability, beside being plainly visible to animals. This, as every farmer knows, is a matter of great importance.



RUANE'S IMPROVED WIRE FENCE.

ENGINEERING INVENTIONS.

An improvement in car couplings, patented by Mr. Reuben Jones, of Mountville, Ga., consists of a draw head pivoted in a draw bar, and adapted to be raised or lowered by a lever operated from the side of the car to couple cars of different heights, the draw head of one car, carrying a coupling link, striking the draw head of the car to be coupled and forcing back a slide supporting a coupling pin until the hole in the slide registers with the hole in the draw head, and the coupling pin falls by gravity through the link, coupling the cars.

An improved snow plow has been patented by Mr. William W. Osborne, of Kansas City, Mo. The object of this invention is to effect the removal of deep snow from railroad tracks. The surface of the plow in contact with the snow is kept hot, so that the snow will slide off the surface freely, and will be more or less melted, so as to pack and remain in place when thrown from the track. The plow consists of a frame, inner iron plates, coils of steam pipes, and an outer sheet iron casing.

An improved ditching machine has been patented by Mr. Samuel C. Robinson, of Pemberton, Ohio. This invention relates to improvements in a ditching machine for which Letters Patent were granted to the same inventor June 28, 1881, No. 243,624; and it consists in entirely inclosing both sides of the ditching wheel with suitable plates, to prevent the ingress of dirt into the wheel, and dishing the plates from the rim of the ditching wheel to its center, whereby the thickness of the ditching wheel is greatest at its rim, and the side plates will not interfere with the sides of the ditch in excavating it.

An improved car coupling has been patented by Mr. Moses Robeson, of Galena, Kan. The object of this invention is to provide a car coupling by means of which two cars can be coupled together and uncoupled without running them together while the link is being adjusted, whereby danger to life and limb in coupling cars shall be obviated.

Messrs. Ephraim Phillips and William H. Cox, of New Castle, Pa., have invented improved car coupling and detaching devices which may be operated without going between the cars, and which may be used upon cars whose drawheads do not meet in the same horizontal plane, and which may also be coupled with any common link and pin coupler.

Cow Stables.

To construct gutters in cow stables so as to insure cleanliness the *Ohio Farmer* says:

First drive in your largest or longest cow, and chain her up in the back stall; next, drive in your smallest or shortest cow in the front stall. Then give them meal or other feed in their mangers, and while they are standing quietly and comfortably eating, seeing that they are standing squarely on their feet, carefully mark the position of the hind feet upon the ground, and draw a line between these points across the entire stable. This line will mark the position for the front edge of the manure gutter or trough. Back of this line dig out a square ditch, 16 inches wide and 8 or 10 deep. Into this drop your plank gutter, which should be made of two-inch plank. The bottom plank should be 12 or 16 inches wide, and the sides from 6 to 8 inches wide, according to the method adopted of spiking them together, so as to leave your manure gutter full 12 inches wide in the clear, and not less than 6 or 8 inches deep. The top of this trough must be well braced at intervals of 8 feet to prevent the pressure of the earth from forcing in the side planks and thus making the gutter too narrow at the top. These gutters must be well cleaned every day while the cows are out for water and exercise, and a slight sprinkling of chaff or short straw shaken over the bottom for an absorbent, and to keep the cows' tails out of the liquid manure when lying down. The gutter must have an inclination from the back part of the stable to the front, and a free discharge through the wall of the barn into the barnyard, where other absorbent matter should be ready to receive it. No littering of these gutters would be necessary, were it not for the fact that the passage of the liquid manure will be more or less obstructed or clogged by the solid manure after the stables have been occupied several hours. The platform on which the cows are to stand and lie should also have a slight inclination to the manure gutter. The proper length of this platform I have found to range from six feet in length for the longest cow down to five feet long for the shortest cow. Back of the manure gutter should be a passage way or walk of suitable width for the wheelbarrow and the milkers. These distances will determine the proper dimensions for a cow stable, which is not less than twelve feet in depth, and of any length desired, according to the size of the barn or the number of cows. The width of the stalls should be from three to four feet. The next best method which I have seen practiced of keeping cows clean in winter is to leave them unchained in box stalls six by eight or ten feet, keeping them well cleaned and littered every day.

Straw in the Manger.

It is not at all difficult to rot down a straw pile, and by so doing to germinate and kill most of the weed seeds contained therein; by making the stack very flat, so as to catch much water, it rots rapidly, and so soon as it gets once thoroughly wetted, by repiling, it soon heats and decays. But the stack or pile of straw at best only contains carbon and silica in quantities, and these are the most common and least valuable of all the elements of plant food. The quantity of potash, nitrogen, and phosphoric acid is very small indeed, and there is no method by which this pile of straw can in any way be changed into manure containing any more of these valuable elements than were in the stack originally. If we tread this pile down it will only be a pile of wet straw, and if we rot it ever so thoroughly it will only be a smaller pile of thoroughly rotted straw, and at best little better than so much swamp muck. It is only by the use of straw as an absorbent, and as a coarse food for fattening animals, and by using with it much rich food, such as corn, bran, oil, or cotton seed meal, etc., that we can change it into a manure that shall really be very valuable to use, and that will largely increase the crops where used. We must not expect that we can raise large crops of grain year after year, and sell the most valuable part, and by any method turn the straw into a manure that shall keep up the fertility of the soil, if we manure only with straw we must expect to grow only straw upon the land. It is unfortunate for any man to be so situated that he cannot afford to raise stock to eat up and tread down the straw, and to be fed richer foods, so as to make a full supply of rich manure. With any system of farming we now have, the land must, sooner or later, become exhausted and cease to yield profitable crops if we fail to return to the soil the essential elements of plant food removed in such crops.—*J. S. Woodward, in N. Y. Tribune.*

KOHLER'S EXTINGUISHER FOR ARGAND BURNERS.

The engraving shows a very simple and effective extinguisher for kerosene lamps, recently patented by Mr. C. H. Kohler, of 235 Superior Street, Cleveland, Ohio. The device answers the double purpose: First, of an extinguisher for use whenever it is desired to put out the light in the safest and most convenient manner without blowing into the chimney or turning down the wick—either of these methods being very dangerous; and, second, of an automatic extinguisher, which insures the instantaneous putting out of the light should the lamp be turned over, thus preventing the fires which are so frequently caused by kerosene lamps being upset.

Many of the accidents resulting in the destruction of life and property might have been avoided had this safety device been used.

KOHLER'S EXTINGUISHER FOR ARGAND BURNERS.

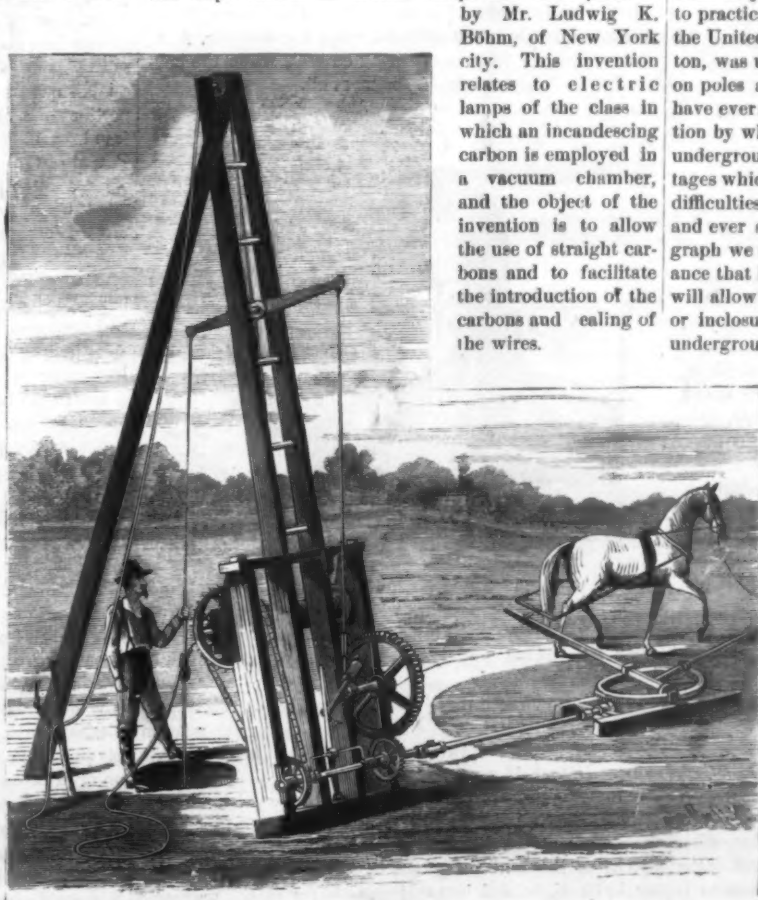
Fig. 1 shows a lamp with the improvement attached; Fig. 2 is a sectional view, showing the manner of operating the device by hand; and Fig. 3 shows a lamp partly overturned, with the extinguisher being operated automatically.

A sleeve is fitted over the outer side of the wick tube and connected by a wire arm with a smaller tube within the wick tube. The lower end of this tube rests upon a support inside the wick tube. Air to supply the flame is admitted to this tube through an opening in its side. A lever pivoted in the side of the burner extends into a slot in the inner movable tube, and has at its outer end an eye, to which is attached a chain carrying at its opposite end a small metallic ball having sufficient weight to move the connected sleeve and tube, so that whenever the ball is displaced from its socket, in case the lamp should be overturned, it drops, and in its fall raises the extinguishing device and shuts off the supply of air to the flame, which then goes out instantly. To insure a direct pull on the lever, the chain passes through an eye formed on the end of a wire projecting from the side of the burner. To operate the device by hand, all that is required is to press on the lever.

IMPROVED DRILLING MACHINE.

We give an engraving of an improved machine for operating vertically reciprocating rock drills for sinking wells, prospecting for minerals, etc. A walking beam is fulcrumed in the upper portion of the derrick, and connected at one end to the drill rope, the other end being connected with a rope that is alternately drawn up and released to give a vertically reciprocating motion to the drill.

At the lower end of the derrick there is a frame formed of four upright parallel bars, two of them being integral with the derrick bars. These bars are connected together at the top and bottom, forming the frame. In the upper part of this frame the winding frame is journaled. Below this is the crank shaft, having a large spur wheel, which is driven by a small spur wheel on the lower shaft; the latter receives its motion from the tumbling rod of the horse power.



GILES' DRILLING MACHINE.

The crank on the middle shaft consists of a straight bar of iron connected at the middle with the shaft, and carrying a slide which moves freely on it, and is connected with the operating rope extending upward to the walking beam. When the crank completes, or nearly completes, a half revolution after the walking beam is moved so as to raise the drill, the slide slips to the upper of the crank bar and allows the drill to descend. This operation is repeated at each half revolution without lost motion, without any swinging or whipping of the drill rope, and without sudden strains or jerking on the horse traces or machine.

The winding drum receives its motion from the lower shaft through an endless chain, and the lower chain wheel and the small spur wheel are loose upon the driving shaft, and both are capable of being engaged by clutches operated by the hand lever.

This derrick can be used for boring as well as drilling.

The machine is very simple, and possesses all of the qualities necessary to make it effective and economical of power. It is compact and portable, and may be set up and operated with very little trouble.

This drilling apparatus is the invention of Mr. William W. Giles, of Washington, D. C. For further particulars address the United States Manufacturing Company, Washington, D. C.

MISCELLANEOUS INVENTIONS.

Mr. Martin W. Speulda, of Springfield, Ill., has patented an improvement in fare registers of that class which are to be carried by the conductor, and operated as each fare is received, to register the number of fares taken. The invention operates upon a common general principle, in that it has a pull bar which gives a step-by-step movement to a train of wheels bearing numbered dials, and simultaneously rings a bell at each movement.

An improved nose feed bag has been patented by Mr. Charles J. Gustaveson, of Salt Lake City, Utah Ter. This invention relates to nose feed bags which have perforated bottoms; and the improvement consists in a perforated bottom, in combination with a supporter having protecting cross-stays.

Messrs. Ira Robbins, of Camden, N. J., and David Heston, of Philadelphia, Pa., have patented improvements in machines for grounding wall paper before printing. It consists of devices by means of which the pressure of the impression roll on the paper in contact with the grounding roll may be increased or diminished, as desired.

Mr. George W. Golay, of Middle Grove, Mo., has patented improvements in devices for increasing or lengthening the throw of the connecting rod of reciprocating engines, which consists in the peculiar arrangement of levers similar to that of the well-known lazy tongs.

An improvement in sleighs has been patented by Mr. Theodore F. Westervelt, of Mount Pleasant, Mich. The object of this invention is to construct a sleigh in such manner that greater strength shall be secured to the several parts than is possible where the timbers are mortised, and at the same time repairs can be easily and cheaply made. The invention consists in a sleigh having sockets of peculiar construction for holding the timbers together, and braces combined with the sockets for supporting the cross-beams.

An improvement in electric lamps has been patented by Mr. Ludwig K. Böhm, of New York city. This invention relates to electric lamps of the class in which an incandescing carbon is employed in a vacuum chamber, and the object of the invention is to allow the use of straight carbons and to facilitate the introduction of the carbons and ealing of the wires.

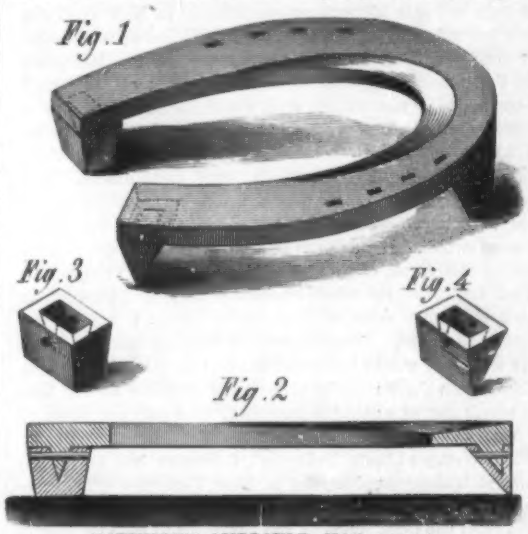
An improved fishing rod has been patented by Mr. Thomas H. Chubb, of Post Mills, Vt. The invention consists in combining braid, cords, and ferrules with the circumferentially grooved butt of a fishing rod.

An improved cuff or collar fastening has been patented by Mr. Mahlon Loomis, of Lynchburg, Va. This invention consists in a strip of metal bent at each end in opposite directions to form spring hooks, having the inner surfaces roughened or serrated and the curved portions corrugated.

Mr. Ludwig K. Böhm, of New York city, has patented an electric lamp of the arc type, in which the carbons are contained in a vacuum chamber of glass. The object of this invention is to provide for convenient renewal of the carbon and insure uniform feed of the positive carbon to compensate for waste. The invention consists in a carbon holder of novel construction, combined with a separable vacuum chamber.

IMPROVED HORSESHOE.

The engraving shows an improved horseshoe having calks that can be readily applied or removed as may be required. The shoe is provided at the heel and toe with permanent lugs of wedge form, which are adapted to recesses of similar form in the calks. Calks of any required form may be



ROBINSON'S IMPROVED HORSESHOE.

used in connection with this shoe. They are held in place by pins passing through both lug and calk.

The form of calk may be either smooth or sharp. It has ample strength, and is not liable to be broken. Use tends to tighten the calks on the shoe, and, as there is no wear on the lugs, the shoe will last a long time, the calks being renewed from time to time.

This simple device permits of changing the calks at any time and place without special tools or appliances.

This useful invention was recently patented by Mr. Francis T. Robinson, of Lauraville, Md.

Underground Telegraph Wires.

This subject is one that may be called new to the great mass of people in the United States, but it is an old subject to practical telegraphers. The first telegraph line built in the United States, which was from Baltimore to Washington, was underground. It did not work until it was placed on poles above ground, as at present. Telegraph builders have ever since been trying to ascertain some means or invention by which it can be made practical, and work as well underground as it does above ground, without the disadvantages which are common to the present system. Electrical difficulties in this have been eagerly sought to be overcome, and ever since the practical working of the electrical telegraph we constantly hear of some new invention or contrivance that has been discovered in Europe or America that will allow underground wires in a cable, or tube, or coating, or inclosure of some kind, to work as easily and as well underground as if placed above ground on poles. We may emphatically say that, up to the present time, they have all fallen far short of what has been claimed and expected of them, and that in many instances and circumstances they are an absolute failure, when the most useful and practical instruments for transmission are to be used, and also in long lines. Germany has been laying underground "compound submarine cables" rather recklessly without knowing their durability, and it is thought by practical electricians that, when one wire of the compound series fails, which it may do in a few years, their experiment will be a costly one. It is already proved that there is much loss of speed, and difficulties of sensitiveness and induction and loss of powers of transmission, although the lines are comparatively short. It is eminently a war telegraph system—safety in war, slow in peace. These are the electrical difficulties which are unknown and unheard of by the popular ear. They effectually consist of the non-user or abolition of the automatic instruments by

which many hundred words are transmitted and recorded in a minute, and also the abolition of the duplex and quadruplex instruments (by means of the latter four messages are sent over one wire at one time, thus answering the purpose of four distinct wires), and the duplex answering for two distinct wires, and last of all, which has suddenly come upon us, the telephone, with its still more sensitive apparatus.

After all these electrical difficulties are overcome or dispensed with, the practical difficulties still remain, the main one being that of cost, while convenience must also be considered.

In this practical age convenience is regarded more than cost in many instances. In this instance the cost of placing all telegraph lines under ground in cities and towns with anything like the present convenience and facilities will be such as to make it too expensive for popular use, which in the end would be a practical prohibition of its use.

Without detailing the manner of its construction in London, which is on the elevated railroads and taken down at stations, and Paris, which is in its sewers, we can say that none of the advantages and modes of its construction in those cities exists in any of our American cities.

We will take New York city as an example. In Paris there are only 80 miles of underground lines. In New York city there are 9,000 miles of line in the streets and on house-tops. Of these over 3,500 belong to and are used by the Metropolitan Telephone Company. The Gold and Stock Telegraph Company have many miles upon which the automatic instruments are used. The Western Union has 1,200 miles of wire, of which only about 300 miles are on the main trunk lines, and the remaining 900 supply the little local offices. It is the many local offices and places where instruments are set that is to be considered in this question of laying underground cables. If one man in a block desired communication by telephone, or the use of the Messenger Telegraph or Stock Indicator, the whole expense of digging a trench from the main office must be considered. This would greatly narrow their use. The expense for digging the trench for one wire only would be almost as great as for many of them. Then again there must be places near together on the lines by which any wire could be taken out for repair and replaced if necessary.

The Western Union Telegraph Company has now three lines of underground cables in New York city. They are in three iron tubes about three inches in diameter each, and lead from the main office of the company to Pier 18, foot of Cortlandt street, North River. In these three tubes is a cable of thirty wires each. These are conducted under the Hudson River to Jersey City.

When first laid, about five years ago, there were only the two tubes and the two cables in them. The expense of laying them from the main office to the river was at the rate of $15,000 per mile, the cables each costing at the rate of $5,250 per mile. About one year ago some of the wires in the cable failed to act, and one cable was entirely taken out and replaced by a new one. Another tube and cable was also then placed in the trench. The expense of often replacing must also be considered, for if some of them fail it may be necessary to entirely renew the cable. The sum of $7,500 per mile for laying underground cables is great when compared with the cost of a line of poles in the city, which rarely exceeds $150 per mile, capable of carrying many wires. In places where smaller and shorter poles can be used the expense is very much less, even as low as $75 per mile in cities, and much less in the country. Increase of expense implies a necessary increase of rates. The interest on the cost of a mile of underground line will be sufficient to build at least four new lines the same length every year, which will last from twelve to fifteen years each, the wire costing only $15 per mile.

The popular objection urged against the present system is that the poles and wires are "unsightly." When this is closely examined it shows it to be mere clap-trap and without any reasonable foundation, and it will more strongly apply to every means of economical and convenient carrying of merchandise and passengers in cities, without any of the chief annoyances which appertain to the latter.

Surely, the means of the conveyance of intelligence is as important and as great convenience in a community as the conveyance of persons and of merchandise. Indeed, this mode of carrying news saves much personal travel by messenger or otherwise.

The day has not yet arrived when underground telegraph lines in American cities will prove a convenience and be a popular success, as some will try to make others as well as themselves believe. The facts of science are stubborn things and cannot be removed or dispensed with by popular opinion or legislation.—*Journal of the Telegraph.*

M. Gaiffe's Sulphate of Copper Battery.

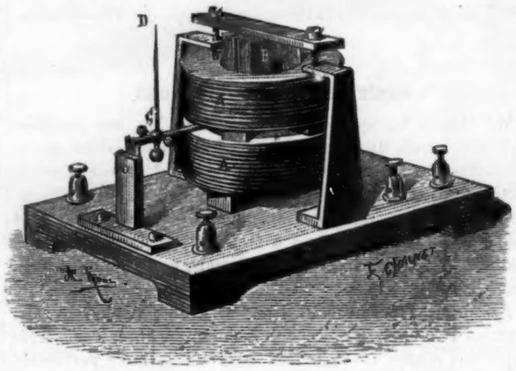
This is an improvement on the Daniell element, and is intended to put a stop to the reaction of the zinc on the sulphate of copper when the circuit is open. The apparatus consists of a glass cell, at the upper part of which is the zinc, constructed as in a Calland element. The central vessel has a porous upper portion fixed upon a non-porous lower portion, which may consist of an ordinary drinking glass. The copper cylinder placed in the central cell has a prolongation which is bent down so as to reach down to the bottom of the outer cell, where it terminates in a ring. This element is charged by means of a concentrated solution of zinc sulphate of magnesium sulphate, while some crystals of copper sulphate are placed in the bottom of the central cell. On dissolving, the copper sulphate first saturates the liquid in the non-porous part of the central cell, and when the copper solution reaches above the top of the non-porous part it traverses the porous cell, and falls, in virtue of its superior density, to the bottom of the outer cell, beyond the reach of the zinc. This passage of the copper sulphate is effected slowly, and the circuit may be left open for weeks without any deposit of copper being perceived on the zinc. When the circuit is closed this element first reduces the sulphate of copper which has fallen to the bottom of the outer cell, the liquid in which soon resumes its original purity, and the action then continues as in an ordinary Daniell element.

RHEOMETRIC APPARATUS.

BY MARCEL DEPREZ.

As an example of the arrangements of rheometric apparatus belonging to the different classes cited in a preceding article, I shall describe two instruments that I had constructed some time ago. The first of these (Fig. 1) consists of a soft iron needle mounted on a horizontal axis movable

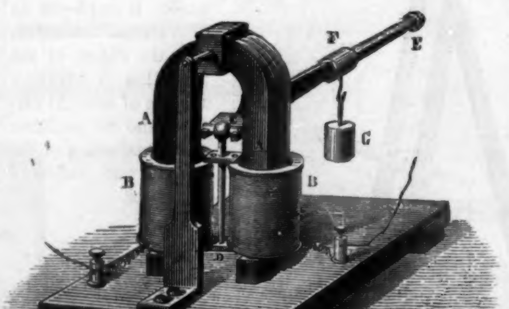
Fig. 1.



about two knife edges, and inclosed within a galvanometric helix, B B. The helix is placed within a pair of large bobbins, A A, wound with a wire of pretty large diameter, into which is sent a current from a Bunsen pile. The axis of the iron needle terminates at C in an index, and in a system of small masses movable on screws, the purpose of which is to balance the whole.

To employ this instrument, there is first sent into the wire of the bobbins, A A, a current from some energetic and constant source, such as a Bunsen element. The result is that the soft iron needle becomes magnetized to saturation, and places itself spontaneously in such a manner as to coincide with the axis of the bobbins, A A; but it is proper to remark, also, that it is directed at the same time as magnetized. If, afterwards, the galvanometric helix, B B, be put in relation with any source whatever, the needle will behave like the magnetized needle of an ordinary galvanometer, and its deflection will depend upon the intensity of the second current and of the directing force developed on it by the bobbins, A A. Now, this directing force may be rendered as feeble as may be desired in two ways: (1) by increasing the diameter of the bobbins, A A; and (2) by acting upon one of the regulating masses in such a way as to place the center of gravity over the axis of rotation until the equilibrium is almost indifferent, when the bobbins, A A, will be traversed by a magnetizing current, while the bobbins, B B, will be traversed by none at all.

Fig. 2.



It will be seen, then, that this instrument is a galvanometer in which the needle may be magnetized with great energy, while the directing force may be rendered very feeble, these being conditions that we always try as much as possible to obtain.

It will also be seen that it constitutes likewise a *comparer of currents;* that is to say, an apparatus giving the relation of the intensities of two currents and not their absolute value. In fact, if two currents are simultaneously sent, one into the bobbins, A A, and the other into the galvanometric helix, B B, and if care has been taken to destroy every species of foreign directing force, by causing the center of gravity of the movable system to coincide with the axis of the knife edges, and by placing the latter in the magnetic meridian, the soft iron needle will assume a position of equilibrium, which will not change whether each of the currents be doubled, tripled, or quadrupled. But this position of equilibrium will change, on the contrary, if the intensity of a single one of the currents be altered. In order to demonstrate this property experimentally, the two bobbins, A A, B B, may be united in derivation on a same curve; when, the law of the division of the current between the two bobbins depending only on their respective resistances, the deflection of the needle will be seen to remain the same as long as these respective resistances are not altered, whatever be the intensity of the total current. If, on the contrary, by any means whatever, the resistance of one of them be altered, the position of equilibrium of the needle will immediately change. Owing to this property, this instrument might become a measurer of resistance which should indicate, by a simple reading, the resistance of a wire into which was sent a current of any intensity whatever.*

Becquerel's Balance, modified.—The second instrument is based on the same principle as the Becquerel balance. It consists (Fig. 2) of a powerful magnet, A A, whose arms are surrounded by the two bobbins, B B, in such a way that the distance between the pole of each arm and the lower armature of the corresponding bobbin is equal to about a third of the total length of the latter. The two bobbins are mutually interdependent, and are connected with a knife edge, C, supported by the small lever arm of a steel yard, C F, whose long arm carries a weighing slide, F, to which may be hooked a supplementary weight, G. The magnet is stationary and the bobbins movable, and receive the current, either through mercury cups or through a very fine and flexible wire, wound in the shape of a helix, whose elastic force is altogether feeble and yet constant. This apparatus possesses an advantage over the Becquerel balance in having a very intense magnetic field, while in the latter the magnets are formed of small iron bars 4 to 5 millimeters in diameter. It might be objected that the weight of the bobbins being much more considerable than that of the bars of the Becquerel balance, there would be lost, as a consequence of this surcharge imposed on the balance, the benefit resulting from the increase of the mechanical action of the current. But it is necessary to remark that the weight of the entire movable portions of the balance is greater than that of the movable bobbins, and that, consequently, in these two instruments, the balance is placed perceptibly under the same conditions of sensitiveness, while the absolute mechanical effort, at an equal intensity with the current, is much greater in this apparatus than in that of Becquerel. The model shown in Fig. 2, although roughly constructed, has in fact exhibited a remarkable sensitiveness. I think, then, that this apparatus, when better made, might render genuine services.—*La Lumière Electrique.*

MECHANICAL INVENTIONS.

An improvement in machines for making dough into cakes has been patented by Mr. Daniel M Holmes, of Cincinnati, O. The object of the inventor is to secure an even and constant feed and pressure to the valves and cutters. With the use of the ordinary dough box and plunger in cake machines considerable time is lost in the intermittent action of the feed. Mr. Holmes has, therefore, provided means of accomplishing an even and constant feed and delivery, whereby the time usually consumed in recharging the machine is saved, and a consequently larger yield of goods in a given time is effected.

Mr. Henry H. Norrington, of West Bay City, Mich., has patented an improvement in the class of punches or perforating stamps designed for use in banking and other similar establishments for the purpose of puncturing or cutting out portions of a check or other written instrument to prevent fraud by alteration. This inventor has obtained Letters Patent of the United States for stamps or punches of this class, and the present invention is in the main an improvement upon that which forms the subject of patent No. 223,161, granted to the same inventor December 30, 1879.

Messrs. Levi L. Lukens, of Chester, and Henry Holcroft, of Media, Pa., have patented an improvement in shuttle boxes for looms which consists in a peculiar construction and arrangement of the parts, by which the second spindle, as ordinarily used, is dispensed with, which permits of an increasing width of the picker strap. There are other points in the invention which cannot be described without an engraving.

An improvement in the class of machines adapted for soldering the heads of paint cans and other cylindrical vessels to their bodies has been patented by Mr. Henry R. Robbins, of Baltimore, Md. It is more particularly an improvement in machines which are adapted for using solder wire, the latter being wound upon a reel, from which it may be drawn off as required and fed into contact with the heated soldering irons and can seams. In this machine the wire reels and mechanism for drawing off the wire are operated simultaneously with the rotation of the can by means of friction gearing, which is put in operation by treadle mechanism. The soldering appliances are also arranged for a certain simultaneous and automatic action. The soldering irons are pivoted and adapted to vibrate between the can-holders and an open furnace, so that they may be swung forward to press on the can seams, and backward to enter the furnace, where they are heated preparatory to the next operation.

An improved car brake, patented by Messrs. William A. Kearney and Joseph G. Davis, of Logansport, Ind., consists in a novel arrangement of a cam for drawing the brake chain

* Mr. Carpentier has recently constructed a resistance measurer based on an analogous principle.

with an increasing leverage, and in levers, pawls, and ratchets for operating the brake.

Mr. William W. Whitmore, of Defiance, O., has patented improvements in that class of tire setters and coolers in which a table carrying a wheel is raised and lowered in a tank containing water to cool and set the tire. The inventor dispenses with the center post ordinarily employed, and is readily enabled by operating the lever to immerse the table and wheel in the water in the tank and hold it in any desired position.

An improved vehicle axle has been patented by Mr. Henry Dugan, of Mount Pleasant, Mich. This invention consists in an axle having a bearing thimble screwed on its outer end and a sleeve with an annular shoulder screwed on the inner end of the beveled part of the axle, passing into the axle box, the axle box being held on the axle by a threaded collar screwed into the rear end of the box and resting against the shoulder of the sleeve at the inner end of the beveled part of the axle.

A lifting-jack for wagons, of improved and simplified construction, has been patented by Mr. John C. Beard, of Newtonville, Ind. This invention consists of a bifurcated upright frame carrying a vertically sliding bar, provided at its upper end with a stepped head-block, the bar and head-block being adapted to be raised and supported in its elevated position for holding the load by a hand lever pivoted at its end to the vertically moving bar, in connection with a swinging connecting bar pivoted to the frame and to the lever.

The Dangers of Hydrofluoric Acid.

[The subject of this distressing accident was Mr. Robbins, assistant in the chemical laboratory of the Institute of Technology, Boston, Mass. The patient is a man of very acute observation as well as a considerable degree of medical information, and I urged him to prepare an account of his experience with this acid, as it was the first case of injury of this kind I had ever seen. He acceded to my request, and the following paper, with a few unimportant changes, is his own account of this rare occurrence.

ALBERT N. BLODGETT.]

"Fluorine as an element is as yet unknown, it never having been isolated. The reason of this is that it is so destructive to all apparatus used for the purpose. It has been studied in its compounds and reactions, and its atomic weight has been determined indirectly. It is the only element which has no known compound with oxygen. It unites with many other elements as a monatomic acid radical, and forms fluorides and also forms quite a number of double salts. Nearly all these compounds affect glass in the presence of moisture. Its hydride is a strong acid like that of chlorine and is a gas. It dissolves many of the metals to form fluorides, is easily absorbed by water, and the liquid acid is obtained by saturating distilled water with the gas. It has little effect upon platinum or lead, and is transported in gutta percha bottles as it affects neither this nor wax nor paraffine, but its action upon other organic substances is often very energetic. I once attempted to redistill some of this acid as it is formed in these bottles, but neglected to dilute it one half as is usually done when it is wished to condense it without a freezing mixture. When heated, the gas began to come over without condensing. It charred the wooded box which surrounded the receiver and dissolved and volatilized a piece of writing paper which was exposed to it, leaving only a slight film of a gelatinous substance, probably the gum from the sizing of the paper. Concerning the action of this acid upon animal tissues little is known. Wurtz's dictionary gives the fullest account of it which I have been able to find. He says, in substance, that it corrodes the skin, giving rise to insufferable pain, and produces a deep ulcer which is very difficult to heal; small drops of it being sufficient to produce white and painful blisters. I had not read this, and was not aware of the great severity of the action of this acid, and I carelessly used the stump of a match, the wood of which was saturated with the acid above referred to, to remove the lime, etc., from the surface of a piece of porcelain so as to obtain the freest action on the part where I desired to etch a hole through it. When I first noticed that it was getting upon my fingers I washed them and greased them with tallow, and thinking they were sufficiently protected I went on with my work. For about an hour and a half I had the match in my fingers the greatest part of the time. Just before I got the hole through I noticed that the ends of my forefinger and thumb were beginning to be unsensitive, and I felt a curious sort of dull pain that perhaps might best be described by saying that my fingers "hurt" a little. When through, I washed them well, applied dilute ammonia water and washed that off, and then applied bicarbonate of soda, but these measures did not relieve the pain from soon becoming very uncomfortable, and I dressed the fingers in a mixture of linseed oil and lime water, as it felt more like a burn than anything else. This was done between eleven and twelve A. M. That afternoon I made an organic combustion, and the pain gradually increased till toward the last it seemed a question whether the furnace or my fingers were hotter. In the evening I began to feel alarmed, and consulted Dr. Blodgett.

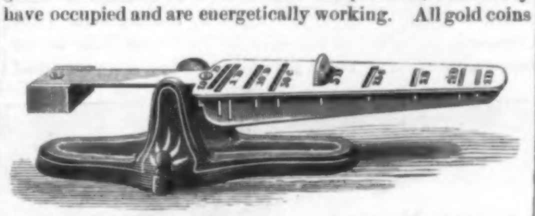
"At this time the ends of the fingers were white and very hard, so hard indeed as to dull the scalpel with which he endeavored to cut away some of the skin. The action was still going on; and as the depth to which it had penetrated could not be determined a dressing of cold cream was applied, and later vaseline was used, but neither seemed to allay the steady increase of the pain, which now most nearly resembled the sensation of a burn when held near the fire. The only relief obtained was by the application of cold, and this was only partial, and the only variation in it was from bad to worse, and at last it became the most severe pain I can imagine, and it was not till four o'clock the next morning, and with the aid of one hundred and ten drops of laudanum, that I was enabled to obtain sufficient relief for a broken nap. The next day the pain had subsided and the acid had penetrated quite a distance below the skin, rendering the flesh totally insensible and hard, having abstracted all the water from it. The other fingers were only slightly swollen, and the swelling did not extend back as far as the hand, showing that the blood was not poisoned at all. My usual good health was only temporarily and slightly impaired by the laudanum, but no other medicine was given. The course of treatment was to remove the destroyed tissue. This it was thought best not to do with the knife, but poultices, alternating with frequent soakings in very hot water, were constantly employed, which proved effectual, although slow in its operation, it being fully twenty days from the time of the injury till the slough was all removed. It was very dry and tough, and by no means inclined to separate from the surrounding tissues. In four weeks I abandoned all dressings to the fingers and was able to use them a little. Only a small permanent loss of tissue has resulted, but now, after three months, the scars are tender and the sensation is perhaps permanently destroyed. This agrees with the action of this acid as stated by Wurtz, especially as regards the pain, but he does not mention the very important fact that no pain is felt for some time after contact with the acid, which in my case was between one and one and a half hours, and by this time the surface has become so hard that it is difficult, if not impossible, to check the action underneath, so that the damage is for the most part done before one finds it out.

"The difficulty in healing appears to consist in removing the slough, as it heals very quickly when this is out of the way, and after the first siege of pain, which is a long and severe one, the sore is no more painful than any other of equal size. I think that should I meet the same accident again I should lose no time in washing it off as thoroughly as possible and then apply water glass if this were accessible; if not, I should use an alkali, and if possible soak the part in water as hot as could be borne, and apply cold cream or some other dressing which will keep the part soft and also exclude the air.

"I have also heard of two other persons who have had misfortune with this acid. They were Dr. C. F. Folsom and a Mr. Lodge. The latter had the end of his thumb badly burned. It was three months in healing, and quite a loss of substance resulted. I think that books on chemistry and teachers of the science should give greater precautions as to the use of this dangerous reagent. From the fact that this acid so effectually hardens animal tissue without distorting it, I think it might perhaps be employed by the histologists as a hardening agent for the soft tissues, especially of the nervous system, as a means of preparing them for microscopical study. I having never known this experiment to be tried, and it would be necessary to use it in very dilute form, but as far as my own observation extends, the action on the tissues would be exactly what is desired."—*Boston Med. and Surg. Journal.*

NEW COIN SCALE.

The return to hard money as a circulating medium has given to counterfeiters a new field for operation, which they have occupied and are energetically working. All gold coins



MCNALLY'S COIN SCALE AND COUNTERFEIT COIN DETECTER.

and the larger silver coins are counterfeited extensively, and genuine coins are debased to a considerable extent. It is said that there are in circulation in the United States over two million of dollars' worth of spurious and altered coins. Counterfeit, altered, and light coins are detected by three methods, by weighing, by measuring the thickness, and by measuring the diameter.

We give an engraving of an instrument that applies these three tests at one operation. The operation is obvious, the slot is exactly filled by a coin of standard size, and the scale is tipped by a coin having the standard weight.

The slots are marked for the various kinds of coin, and the scale is adapted to both gold and silver.

This device is indorsed by bankers and business men generally, and by the United States Treasurer, by the chief clerk of the Post Office Department, and by a large number of influential and prominent business men.

For further information address J. T. McNally & Co., 811 Broadway, New York city.

MAST, FOOS & CO., manufacturers, Springfield, O., were awarded the large gold medal on the "iron turbine" wind engine at the exposition lately held at Adelaide, South Australia, for superior merit. This medal is of the finest Australian gold, and very valuable.

Nature of the Diphtheritic Contagium.

In the spring of 1880, Drs. H. C. Wood and H. F. Formad, under the auspices of the National Board of Health, began a series of experiments upon rabbits with a view of determining the nature of the contagium of diphtheria. The animals were inoculated with diphtheritic membrane taken from the throats of human patients.

In the course of these researches, it was determined that there is nothing specific in the production of false membrane in the trachea, and that traumatic pseudo-membrane accurately resembles the diphtheritic, except that micrococci are not quite so abundant in it. The experimenters conclude that the disease produced by the diphtheritic inoculation was really rabbit diphtheria, because the poison giving rise to it, the symptoms during life, and the *post-mortem* lesions were identical. In addition to this, the contagiousness of the disease was retained. They accept the experiments of Curtis and Satterthwaite, showing that the infectious character of diphtheria depends upon the solid particles of the membrane; furthermore, their researches lead them to conclude that the micrococci are in close relation with the essential poison of diphtheria, being either the virus itself or the producers of it. The results of culture of these bacteria lead them also to assert that there is no difference between the micrococci of simple sore throat and those of diphtheria, except in activity of reproduction; the two are the same organism, existing under different conditions.

Drs. Wood and Formad believe that the vitality under artificial culture is in direct proportion to the malignancy of the case from which the plant is taken. They have succeeded in producing diphtheria by the inoculation of cultured micrococci, but never with those of a generation later than the second.

M. Pasteur has indicated that an inert organism may become virulent, and *vice versa*, and in the same way they believe themselves able to prove that the micrococci of the mouth are really identical in species with those of diphtheria. That oxygen may be potent in converting a virulent into a non-virulent organism, they regard as probable, from the effects of exposure of dry membrane. The micrococci of a catarrhal angina or trachitis may, under favorable circumstances, be transformed into micrococci of diphtheria, and a self-generated diphtheria (*i. e.*, endemic) ensue, or external conditions may favor the transformation of inactive into active organisms, and these may lodge in the trachea and also cause diphtheria (*i. e.*, epidemic). In the first instance, the disease may spread by organisms exhaled by the breath. Diphtheria will vary in contagiousness according to the development of the virus—malignant diphtheria will be more contagious than the mild endemic form. The conditions outside of the body which favor the transformation of inactive into active micrococci, and agents destroying these organisms, remain yet to be studied.—*Phila. Med. Times.*

A New Method of Embalming Bodies and Preserving Tissues.

Dr. Virodtzeff (*Balsamirovanie*, xi., 164, St. Petersburg, 1881) recommends the following preparation as an efficient agent in the embalming of bodies and the preservation of tissues: Thymol, 5 parts; alcohol, 45 parts; glycerine, 2,160 parts; water, 1,080 parts.

It is cheap, innocuous, free from unpleasant odor, possesses the property of keeping the body soft, elastic, fresh, and life-like, and does not ruin instruments. Thymol is selected as being superior to other antiseptics, and glycerine is added, both on account of its own preservative qualities and to retard the evaporation of the fluid. For the preparation of tissues the same solution is employed. If the cadaver be quite lean, or the tissues very delicate, equal parts of water and glycerine (1,620 of each) are combined with the above quantities of thymol and alcohol. To inject a body, half its weight of the fluid is necessary. A properly embalmed cadaver may be preserved indefinitely under ordinary circumstances, gradually shrinking and mummifying without putrefaction. Specimens are either to be injected with or macerated in this fluid. Maceration must not be too prolonged—the appearance of the specimen should act as a guide. The part, after having been thoroughly cleansed in water, and prepared, may then be exposed for months to the air without losing its consistency, form, and color. Permanent specimens may be inclosed in a hermetically sealed glass vessel containing a little of the same solution. The *Medical Record* says that Dr. Peabody has used this preserving fluid, with excellent results, in the New York Hospital Museum.

The Cedars of Lebanon.

Regulations were lately issued by Rustem Pasha for the guidance of travelers and others visiting the Cedars of Lebanon. These venerable trees have now been fenced in, but, with certain restrictions, they will continue to be accessible to all who wish to inspect them. In future no encampments will be permitted within the inclosure, except in the part marked out for that purpose by the keeper, nor may any cooking or camp fires be lighted near the trees, a regulation that has been rendered specially necessary by the partial destruction by fire of three of the largest cedars. Lastly, no animals will be allowed to enter the inclosure and the keeper of the ground has orders to hold the dragomans and tourists' guides responsible for any infraction of the regulations.

of magnesium sulphate, while some crystals of copper sul- | equilibrium, which will not change whether each of the cur- | * Mr. Carpentier has recently constructed a resistance measurer based on an analogous principle.

EXPLOSION OF TWO BOILERS AT PITTSBURG, PA.

On the 9th of December, about five o'clock, P.M., the heavy, dull sound of a disastrous boiler explosion reverberated among the hills of the busy city of Pittsburg, Pa. Two boilers of the nine composing the steam system of the Keystone Rolling Mills, shown in Fig. 1, situated in the Fourteenth Ward of the city, exploded with astonishing violence, causing the death of two workmen, injury to ten others, and the total wreck of the boiler house and adjacent blacksmith's shop, as well as a portion of a building belonging to a neighboring copper works.

Cornelius Dunn, the fireman, who was at the rear of the boilers, was instantly killed; Alvas Gideon, a blacksmith's helper, at work in the smithy, was shockingly injured; and John Price, a puddler, whose skull was crushed, died the second day after the explosion. Although the citizens of Pittsburg and of the iron regions in its vicinity are not strangers to the destructive effects of boiler explosions, yet this double disaster completely bewildered the average native observer; and, judging from the duration of the inquest, which has been repeatedly adjourned in order to obtain new expert testimony and facts, it appears to have thoroughly puzzled both the witnesses and the court, whose duty and evident desire are to explain the casualty and place the responsibility.

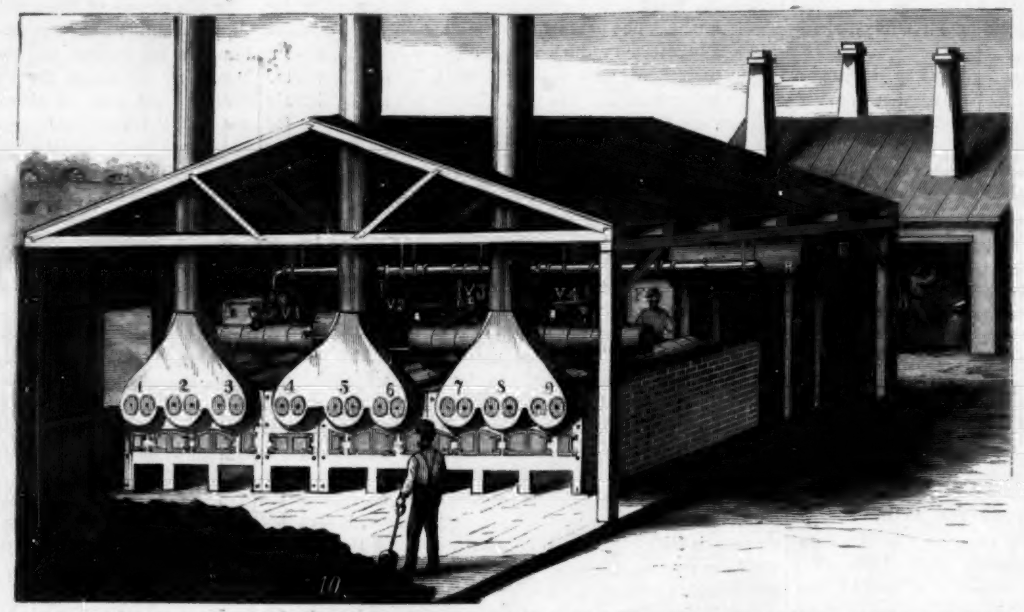


Fig. 1.—VIEW OF THE INTERIOR OF THE BOILER HOUSE OF THE KEYSTONE ROLLING MILLS, SHOWING THE ARRANGEMENT OF THE BOILERS BEFORE THE EXPLOSION.

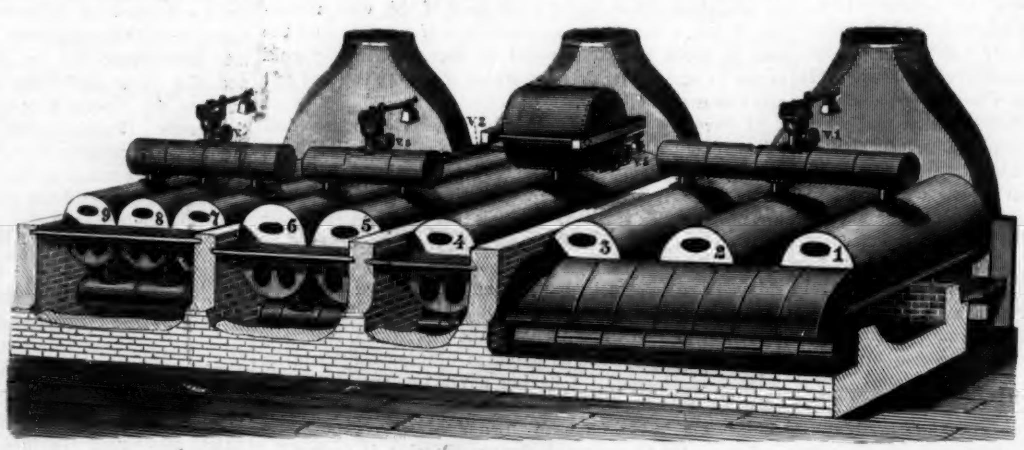
A short history of the case, accompanied by our illustrations, will show that the task of the coroner, so far as the cause is concerned, ought not to be very difficult, since the cause is not obscure when sought for by means of a systematic study of all the phenomena, without bias caused by local or personal interests or preconceived and fixed opinions on the subject of boiler explosions.

The exploded boilers, numbered 5 and 6 in Figs. 3 and 4, were of the common two-flue type, with flues about 15 inches diameter, quarter inch thick, and shells originally of the same thickness, 42 inches diameter, and 24 feet long, made in twelve rings or courses of plates, two plates to each course. They were allowed, by the city inspector's certificate, to carry 120 pounds of steam pressure, but the evidence shows that it required 130 pounds to run the mills at full speed, and that they were working at about 125 pounds at the moment of the explosion.

According to one or more witnesses, it appears that these two, which were over the same fire, and had a separate steam drum and a mud drum, shown in Fig. 4, common to the three composing the second set, were made for and used on a river steamer, the Carrie Brooks, which formerly ran between Pittsburg, Pa., and Zanesville, Ohio. But, according to another witness, the proprietor of a spice mill in Pittsburg, it appears that they were new when put into his mill in 1866. His testimony shows that although he used them at only 40 pounds pressure, that being all he required, yet they were "*all the time giving out*," and he became disgusted, and sold them for $100 each to a dealer in such goods, in 1872. They were bought by the National Tube Company, in 1879, and placed in the Keystone Mills on the recommendation of the city inspector, who, it appears, had tested them at 170 pounds, and reported them as old boilers requiring repairs, which having been made by putting several half-sheet patches, and perhaps some whole sheets, upon their undersides, according to his direction, they were, at that time, allowed to be used at 125 pounds per square inch. Their history from 1872 to 1879 is not clear, perhaps they then were on the steamer Carrie Brooks.

On the 22d of April, 1881, they were last officially inspected as active boilers, in their places at the Keystone Rolling Mills, and allowed 120 pounds per square inch, as shown by the official certificate. The engineer thought he was allowed 125 pounds; as he was the year before, because the safety valve had not been changed to 120.

The above history is condensed from the sworn statements made before the coroner as they were reported for the Pittsburg *Despatch*. Now, if we apply to this case the practical facts, that prudent boiler insurance companies in this country, according to their published tables, would only allow 66 pounds pressure for an old 42-inch shell one-quarter inch thick,* having no important visible defects, and that the Manchester (England) Board of Trade rule would allow but 60 pounds, less than half what had been officially permitted in this case, it seems almost a waste of time to further argue the question of causes of the explosion.



V V.—Steam-stop valve.

Fig. 3.—VIEW OF THE REAR OF THE BOILERS.

But there are in every manufacturing community a large class of practical men who still hold to a variety of old theories on the subject of boiler explosions, and they were unusually well represented before the coroner in this case. In fact, each one of the more common old theories, mysterious and otherwise, had there a zealous champion.

It seems, therefore, important to sketch and answer the most specious of these theories, but the space is not now available for such a review. It may be found, from time to time, under the head of "Steam Boiler Notes," in the SCIENTIFIC AMERICAN.

The accompanying large landscape, Fig. 2, and the diagram, Figs. 5 and 6 (which is a plan of the works), constitute a pretty full graphical description of the scene of the explosion. On these illustrations may be traced the distribution of the fragments of

* The iron was wasted by external corrosion about 25 per cent. of its original thickness, in places near the leaky joints.

5.—Principal part of No. 5 boiler, which was thrown over the church on the bluff.

6.—Principal part of No. 6 boiler, that struck the copper works, etc.

Fig. 2.—EXPLOSION OF TWO STEAM BOILERS AT THE KEYSTONE ROLLING MILLS, PITTSBURG, PA.

the two exploded boilers. Nos. 5 and 6, in the landscape, are the principal fragments, being 16 feet of the length of each of the boilers, which were not broken except at their separating line.

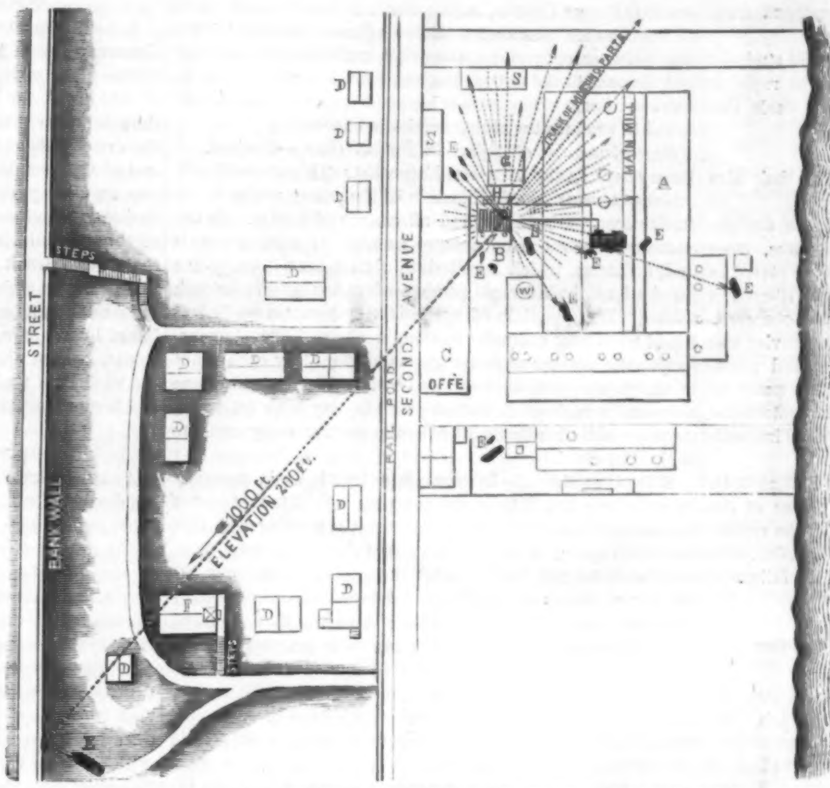
Figs. 1 and 3 show the arrangement of the nine boilers, the former the front and the latter the rear view, as they stood before the explosion. Fig. 4 shows the underside of the two exploded boilers and the lines of rupture, also their relation to boiler No. 4, belonging to the same set. It was two feet longer, and had eleven patches on its bottom.

It will be observed that the middle battery of boilers had two furnaces, a wall between Nos. 4 and 5 boilers forming the division. All the boilers rested upon stand pipes or legs, which connected them to their respective mud drums at the rear, and upon the fire front castings at their front ends.

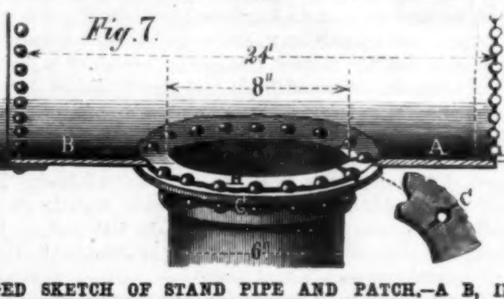
The middle battery was supplied with water through the pipe, G, Fig. 4. The end of the steam drum which was attached to the two exploded boilers is seen at E, while F is the mud drum, common to these three boilers. A patch, consisting of about half a plate, had been put into the shell upon which the stand pipe of No. 5 boiler was riveted, A B, Fig. 4. The location of the initial rupture is pretty well established by the appearance of this plate, which is broken through the stand pipe opening and around the circle of rivets that secured the flange of the stand pipe to the boiler shell. The weakness here is indicated by old cracks on the line A B, and around the fractured edge between the rivets, and by external corrosion of the patch which had been kept wet from the leaks through the cracks and the flange joint. This part is shown enlarged in Fig. 7. These leaks—as no doubt others were that had from time to time called for repairs—was caused by feeding cold water in large intermittent doses in former years. This bad habit was occasionally practiced up to the day of the explosion.

When the main mill engine was running, water moderately heated could be had from the tubular heater, H, Fig. 1, through which the exhaust steam passed; but when the engine was stopped, cold water only could be had, which was fed to the three batteries of boilers alternately as they required it, by a large Blake steam pump, perhaps in large volumes rapidly introduced. Its cooling and contracting effect upon this part of the boiler, together with the brittle quality of the patch and the extraordinary internal pressure, developed the weakness which gradually increased till the limit of endurance was reached. On the day of the explosion these boilers were shut off for repairs. Two hours, or less, before the explosion the flange of the stand pipe (see Fig. 7) had been calked to stop a leak. The boilers were then filled with water to the second gauge, and steam was raised. The boilers were then left in charge of Fireman Dunn, who was directed to feed the water up to three gauges.

Now, when the patch on No. 6 boiler suddenly burst open on the line A B, Figs. 4, 8, etc., the steam gauge had just been observed by a witness to register 127 pounds.



Figs. 5 and 6.—GROUND PLAN, SHOWING LOCATION OF WORKS AND LANDING PLACE OF BOILER. E E, etc., PARTS OF BROKEN BOILERS.



ENLARGED SKETCH OF STAND PIPE AND PATCH.—A B, INITIAL RUPTURE.—C, OLD FRACTURE IN SHELL PATCH THROUGH FLANGE RIVET HOLE.

The pressure of the issuing water was, therefore, about equal to that of a vertical water column 300 feet high, and its temperature was about 355° Fahr. There were nearly 600 cubic feet of free steam in the steam space of the nine boilers, and, supposing the steam valves to be all open, this tremendous volume of steam, at 127 pounds pressure, instantly moved with lightning speed toward this opening, pressing only the portion of water that lay immediately in its path out at the now enlarging opening, the free ends of the broken ring of plates, *a*, Figs. 4, 8, etc., spread outward like wings of a bird, cross tearing the plates on the spiral line indicated (Fig. 4), and on the rear head seam; the left hand free end strikes boiler No. 5, which was almost equally weak at corresponding points, and from the same causes that caused weakening of No. 6 boiler. The blow was sufficiently violent to indent the plate, *a*, where it struck a line of rivets on No. 5 boiler, and it had ample force to so shock the overloaded weak structure as to cause it to break on a line corresponding to A B through the stand pipe opening. No. 5 boiler now opened in the same manner as No. 6 had done, and six tons of highly heated water, that the two broken boilers contained, now relieved of pressure by the instantaneous escape of the free steam, expanded with explosive rapidity, giving out, in falling from 355° to the atmospheric boiling point 212°, 143 units per pound of water. Each pound of the 12,000 pounds of water gave out force enough to raise 143 × 772 = 110,396 pounds one foot high. The grand total of power given out in less than a second of time was therefore 110,396 × 12,000 = 1,324,752,000 foot pounds, a force quite sufficient to accomplish the observed destruction, even though a large percentum of it was diffused in the air, upon which it reacted almost as violently as exploding and detonating compounds do.

It has been repeatedly demonstrated, both by accidental and by experimental boiler explosions, that empty hot boilers do not accomplish a tenth part of the destruction that is done by boilers containing large volumes of water at a temperature due to the pressure.

There was no evidence of a lack of water in these boilers. They were carefully examined by a SCIENTIFIC AMERICAN representative. Moreover, we have the sworn statement of more than one uninjured competent witness that the gauges were tried a few minutes before the explosion, and water showed itself at the upper one.

The boilers were in the care of two engineers and two firemen of long experience, in two watches for the twenty-four hours, each one of whom firmly believed that his life depended on a full supply of water, and that no boiler will *explode* with water at the second or third gauge. They believe that a weak boiler will *blow out* in a harmless manner and relieve itself, as they have often seen them at small and circumscribed areas between rigid supports, or may be at the transverse seams.

The chief aim of these experienced men was to look out for plenty of water and then plenty of pressure to move the machinery at maximum velocity, which one of them swore could only be done with 130 *pounds of steam*.

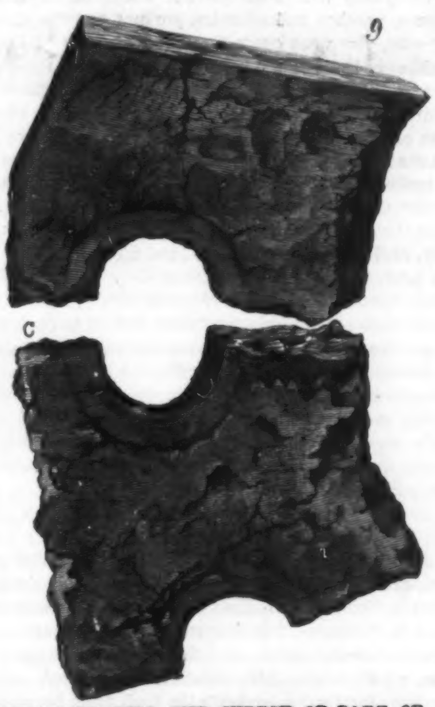
Four rear courses of boilers, Nos. 5 and 6, torn as indicated in Fig. 4, together with corresponding lengths of the four flues, were distributed in about twenty pieces to the right and left of the rear of their site, and the unbroken principal sections, 16 feet of the front ends of both boilers, were thrown as indicated on the landscape at 5 and 6, and plan at E E, etc.

The plate, *a*, Figs. 4 and 8, sailed over and entirely clear of the main mill and landed on the coal pile near the river. This piece was easily identified as the plate *a* of No. 6 boiler by the marks of recent calking at the stand pipe flange. The main section of the same boiler, No. 5, was identified by the gauge cock openings in the front head; the other boiler which exploded, being the middle one, had none. The principal section of No. 6 boiler flew directly to the front and struck a building belonging to the neighboring copper works. The corresponding section of No. 5 was diverted by some incident in the progress of the explosion, so that it took a direction some 30° or 40° to the left, front, and upward over the small church and a dwelling on the slope of the high bluff. It struck almost exactly head foremost against the heavy retaining wall of the street above the buildings, and turning to the front its rear end was flattened against the same wall, and it then landed in the small ravine, as shown at 5 on the large landscape.

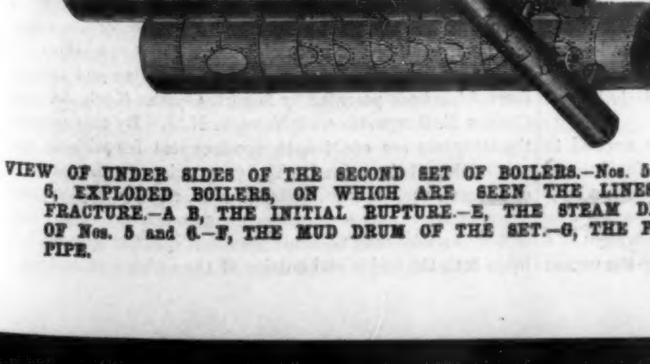
The roofs of the buildings to the rearward of the boilers were covered with *débris* and dried marks of dirty water, pieces of boiler and bricks, all of which point to the same conclusion as to the quantity of water that escaped from the boilers.

Boiler No. 4, the unbroken one of this battery, tumbled over into the pit occupied formerly by Nos. 5 and 6, and lay upon its side in such a manner that most of the water it contained was still there on removing the man-hole plate after the explosion.

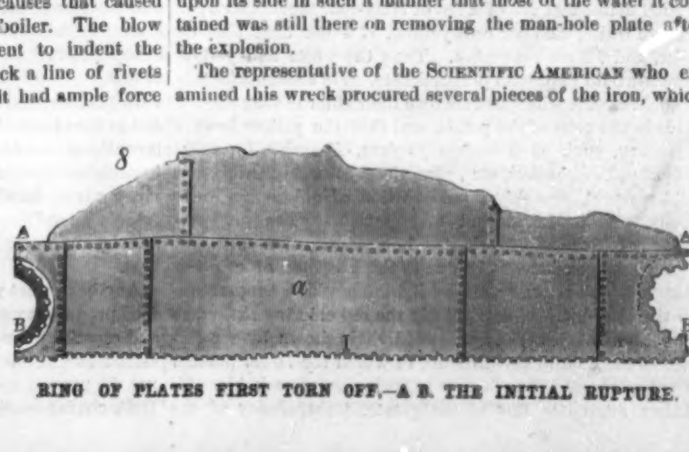
The representative of the SCIENTIFIC AMERICAN who examined this wreck procured several pieces of the iron, which



ENLARGED FULL SIZE SKETCH OF PART OF SHELL PATCH.—C, SAMPLE OF OLD FRACTURE THROUGH FLANGE RIVET HOLES.



VIEW OF UNDER SIDES OF THE SECOND SET OF BOILERS.—Nos. 5 and 6, EXPLODED BOILERS, ON WHICH ARE SEEN THE LINES OF FRACTURE.—A B, THE INITIAL RUPTURE.—E, THE STEAM DRUM OF Nos. 5 and 6.—F, THE MUD DRUM OF THE SET.—G, THE FEED PIPE.



RING OF PLATES FIRST TORN OFF.—A B, THE INITIAL RUPTURE.

OF TWO STEAM BOILERS AT THE KEYSTONE ROLLING MILLS, PITTSBURG, PA.

were easily broken off with a common wrench, indicating its brittle character.

The pieces shown full size, Fig. 9, and also on a smaller scale in Fig. 7, were obtained by cutting off the rivet heads that held them to the flange of the stand pipe, as shown.

They are pieces of the patch, and have, at *c*, a sample of the old cracks that existed before the explosion. These cracks were filled in places with lime scale deposited from the water.

The conclusion is almost inevitable, after careful study—

That these two boilers exploded in succession so rapid as to be practically simultaneous, beginning at the weak line A B of No. 6 boiler.

That they contained the usual supply of water.

That the pressure was too great for boilers of their size and thickness of iron.

That the use of cold feed water has hastened the deterioration of the poor iron, causing cracks and leaks, from which external corrosion arose, and that the force stored in the water of these two boilers by its sudden liberation through sufficient openings caused the destruction observed.

It is, therefore, strongly recommended that heavier and stronger material be used for boilers of this size and pressure; that regular and continuous feeding of hot water be practiced; and that more care be exercised by inspectors and those in charge of steam boilers in searching for and immediately repairing dangerous defects.

The fact that the proprietors of the Keystone Rolling Mills have ordered first-class steel boilers to fill the places of the exploded ones indicates that they appreciated the recommendations of the SCIENTIFIC AMERICAN representative, who explained to their superintendent the causes of the failure of these old boilers.

Chinese Method of Manufacturing Vermilion.

BY HUGH MACCALLUM.

There are three vermilion works in Hong Kong, the method of manufacture being exactly the same in each. The largest works consume about six thousand bottles of mercury annually, and it was in this one that the following operations were witnessed:

First Step.—A large, very thin iron pan, containing a weighed quantity, about fourteen pounds, of sulphur, is placed over a slow fire, and two-thirds of a bottle of mercury added; as soon as the sulphur begins to melt the mixture is vigorously stirred with an iron stirrer until it assumes a black pulverulent appearance with some melted sulphur floating on the surface; it is then removed from the fire and the remainder of the bottle of mercury added, the whole well stirred. A little water is now poured over the mass, which rapidly cools it; the pan is immediately emptied, when it is again ready for the next batch. The whole operation does not last more than ten minutes. The resulting black powder is not a definite sulphide, as uncombined mercury can be seen throughout the whole mass; besides, the quantity of sulphur used is much in excess of the amount required to form mercuric sulphide.

Second Step.—The black powder obtained in the first step is placed in a semi-hemispherical iron pan, built in with brick, and having a fireplace beneath, covered over with broken pieces of porcelain. These are built up in a loose porous manner, so as to fill another semi-hemispherical iron pan, which is then placed over the fixed one and securely luted with clay, a large stone being placed on the top of it to assist in keeping it in its place. The fire is then lighted and kept up for sixteen hours. The whole is then allowed to cool. When the top pan is removed the vermilion, together with the greater part of the broken porcelain, is attached to it in a coherent mass, which is easily separated into its component parts. The surfaces of the vermilion which were attached to the porcelain have a brownish red and polished appearance, the broken surfaces being somewhat brighter and crystalline.

Third Step.—The sublimed mass obtained in the second step is pounded in a mortar to a coarse powder, and then ground with water between two stones, somewhat after the manner of grinding corn. The resulting semi-fluid mass is transferred to large vats of water, and allowed to settle, the supernatant water removed, and the sediment dried at a gentle heat; when dry it is again powdered, passed through a sieve, and is then fit for the market.—*Pro. Pharm. Soc.*

BOTANICAL NOTES.

The Color of Spring Flowers.—In a contribution to the *Science Review*, on the color of spring flowers, Mr. A. W. Bennett states that out of a list of sixty-four species, 40·5 per cent are white, 20·3 per cent yellow, 17·4 per cent blue or violet, and 7·8 per cent pink. Thus the white and yellow flowers would appear to preponderate. He accounts for this by the fact that white flowers owe their color to the presence of air in the cells of the petals, and that the yellow flowers of spring, such as *Tussilago farfara*, *Eranthis hyemalis*, *Primulus*, *Cheiranthus*, etc., owe their color to xanthine, a solid pigment, probably a modification of chlorophyl, only slowly soluble in alcohol and potash. The predominance of flowers of brighter hues during summer and autumn he considers to be due to the presence of coloring matters which require a strong light and a high temperature for their production, particularly the red coloring matter, as shown by Batalin. The effect of light is shown by a reference to the flora of Switzerland, in which the larger portion of red, pink, and blue flowers in spring is remarkable. H. Müller attributes this to the greater transparency of the mountain air, and consequently more intense light. On this account, and because of the spring being a month later than at lower elevations, the alpine flowers are more brightly colored. This explanation is confirmed by Siemens' recent experiments with the electric light.

White-fruited Blackberries.—Mr. G. M. Wilber, in a note in the *Torrey Botanical Bulletin*, reports that in two localities in Dutchess County, in this State, he has detected plants of the common blackberry (*Rubus villosus*) bearing berries that were perfectly white when ripe, and that were as sweet and pleasant to the taste as the usual black fruit of the same species. Some of the bushes having been transplanted were found to produce the albine berries in succeeding years.

Superabundance of Pollen in Indian Corn.—Prof. C. E. Bessey says, in the *American Naturalist*: "Nature evidently intends to secure the fertilization of the young ovules in the Indian corn (*zea mais*) beyond all chance of failure. In the autumn of 1875 I made a large number of careful counts and estimates, which resulted in fixing upon twenty-five hundred as the average number of pollen grains in each anther. Each panicle of male flowers (the "tassel") was found by careful estimates to contain about 7,200 stamens, so that the number of pollen grains produced by each plant is about eighteen millions. Allowing two ears, of one thousand kernels each, to each plant (a very high estimate), there are still nine thousand pollen grains for every ovule to be fertilized!

What is an Apple?—Is an apple a fruit? It is generally regarded so; but, botanically speaking, a *fruit* is that part of a plant which contains the seeds, and it is nothing else. The *core* of an apple, then, according to this, is the true fruit, for that is the part that contains the pips, and the pips are the seeds It is a cartilaginous five-lobed capsule splitting along the edges. "What oddities," says Dr. M. T. Masters, "these botanists are; they leave on their plates the fruit, and they eat something which they say is not the fruit! What is that something which is not the fruit? To answer this question to his own personal satisfaction . . . the reader should see before him a flower of an apple or pear in the earliest stage of its growth, and he should trace in other stages, from this earliest condition to the ripe state, the growth of the apple or the pear." A careful examination of this kind, says our author, will "enable him to discover that the flesh of the apple or pear is nothing whatever but the end of the flower stalk, which gradually swells out into a succulent mass, and which holds embedded within it the true fruit —the core. What in ordinary language is called the fruit is, then, only the swollen flower stalk. Alechemillas and spiræas, peaches and cherries, are not to be h d in flower just now, else a cut down through the center of the flower of either of these would reveal the cup-like stalk encircling the young fruit in the center, just as a pill is inclosed within a pill box. Now, suppose the cup to be fleshy, and so thick as to come in contact with the fruit, and we have exactly the condition of an apple. So, then, to say that the core of an apple is the true fruit, and the flesh thereof the dilated flower stalk, is no dogma to be accepted as an article of faith, but it is a statement which any one with a pair of eyes, ordinarily nimble fingers, and a little patience, can, at the proper season verify for himself. . . . To be able to recognize the core of an apple as the fruit proper, and to see in the flesh of the apple a swollen flower stalk, is not to indulge in a mere botanical technicality, as some might at first be inclined to suppose; but it affords a means of ascertaining a truth, and, as such, of opening up possibilities of future utility and development; for truth is never barren of result —the sterility lies with the man who does not avail himself of the truth so far as he can. Deep thoughts to be evolved from the castaway core of an apple!"

Dried Foods.

At present we export to Europe about 6,000,000 pounds of evaporated apples. The process is extremely simple. The fruit is "cored" and sliced into pieces one-sixteenth of an inch in thickness; it is then exposed to sulphur fumes, which arrest all fermentation, and then to a dry and hot blast of air, which reduces it to about half its original weight. The sulphur fumigation prevents the fruit from becoming dark, and after drying it is almost as white as when first cut. Simple as is this process, it costs about twice as much as drying the fruit in the sun, but such is the saving in weight and flavor that it is preferred, and evaporated apples sell to-day in the European markets for fifteen cents a pound

An old produce dealer interested in the European export trade told an *Evening Post* reporter that, in view of the astounding magnitude of the export trade in food products, it would not be surprising to hear of attempts at compressing or drying every product of the country. The same process as that applied to apples has been used with some success with peaches, and some berries that can be grown cheaply, and as the export of dried food products increases the import is constantly decreasing. The raisins from California promise to drive all foreign raisins out of our markets. There are vineyards of hundreds of acres in Placer, El Dorado, Los Angeles, San Diego, and other counties, given up to growing and drying grapes, partly by evaporation and partly by sun heat.

Another recent use of the evaporation process applied to food products concerns the preparation of codfish for Europe, and especially for tropical climates. The business has been established in this city about six months. The persons who use the process assert that ninety per cent of the weight of a fresh codfish consists of water. By evaporating the matter until the fish product becomes a sort of fine dry meal, a substance is obtained which can be packed in boxes and exported, one pound of the evaporated cod being equal to ten pounds of fresh cod, so far as nutritive properties go. The company which is engaged in the business has factories on the coast of Maine and at Gloucester, Mass.

Wet and Dry Thunderstorms.

A correspondent of the London *Times*, writing from the Transvaal, South Africa, says: "Every afternoon tremendous storms of thunder and lightning burst upon us. These were of two kinds, the wet and the dry. The first is harmless, though noisy; the second exceedingly dangerous. During the dry thunderstorms, which were prevalent toward the end of October, the lightning seemed quite stupefying. It was unaccompanied by either wind or rain. The angry flashes were followed almost simultaneously by awful crashes of thunder, which seemed to shake the earth. One or two tents were struck, and the grass was set fire to in several places within sight of our camps, but no life was lost, only some arms damaged. The dry thunderstorms were soon followed by wet ones. The rain, mixed up with enormous hailstones, soused the thirsty earth, and every little crack on the veldt bore its burden of water to the Vaal, which rose and became impassable."

Oxygen as a Source of Energy.

As is well known, however, the highest temperatures are obtained by combustion—that is, by the combination of other bodies with oxygen. Since oxygen is continually inhaled and consumed by animals during life, we are obliged to consider this as the source of heat and force. We have here a problem which is open to discussion, namely, whether the energy liberated by the combustion was originally contained in the oxygen or in the other substances. It appears as if the latter assumption was generally accepted; at least, statements are often met with, such as, for instance, that coal contains the heat of the sun which has been stored up during thousands of years. Although we cannot at present, with the means at our disposal, definitely solve this problem, it can at least be shown that the statement has little in its favor. The decomposition of carbonic acid by the influence of the light and heat of the sun is effected in such a manner that the carbon is employed in the formation of the compounds of which the plant is built up, while the oxygen escapes into the atmosphere. Now, we know that solids contain the least energy, because it must be supplied to them in the form of heat in order to convert them into the liquid or gaseous state, while, on the contrary, heat must be withdrawn from gases to condense them to liquids or solids. Oxygen is one of the most permanent gases, and must therefore possess an enormous amount of energy, while carbon, on the other hand, being one of the most difficultly diffusible and volatile bodies, can only contain a little energy. This makes it extremely probable that the force of the sun, taken up by the plants, is not stored in their bodies, but in the free oxygen of the atmosphere. Hence the latter is to be considered as the inexhaustible source of power on which man and animals draw, and in the carbon we possess a valuable aid for making this energy, contained in the oxygen, available.—*Edmund Drechsel, in Popular Science Monthly.*

RECENT INVENTIONS.

An improved whip has been patented by Messrs. Henry Mullen and James Noble, Jr., of Westfield, Mass. The core of this whip is formed of a leather or rawhide piece at the butt and a whalebone piece at the lash end, so that the advantage of a whalebone whip is retained, while the cost is greatly reduced.

An improvement in fishing reels has been patented by Mr. John Palmer, of New York city. The invention consists of a fishing reel provided with an extensible crank for increasing the length of leverage when necessary when reeling in the line, the extension arm being adapted to be withdrawn to shorten the lever to ordinary length while casting out the line.

Mr. John Owen Smith, of Savannah, Ga., has patented a means for protecting windows or doors against burglars. It consists in a strong protective frame of metal or wood, provided with lugs at the top, adapted to enter seats formed in plates in the sides of the window frame, and provided with tongues of metal at the bottom, projecting at right angles to the frame inwardly, and adapted to enter horizontal holes in the window sill and be locked by set screws or pins inside.

An improved combined button lap and stay for garments has been patented by Mr. David W. Thompson, of Englewood, Ill. The invention consists in the combination, with the garment or body piece having simply a straight slit cut in it where the opening is to be, of a single piece of material, which, when folded and stitched to the sides of said slit, constitutes both an upper and under button lap or fly, a facing, and a stay for re-enforcing the bottom of the opening, making a finished piece of work without raw edges.

An improved process of making skinless furs and articles thereof has been patented by Messrs. Charles Koch, Jr., and Charles E. Burgmüller, of Newark, N. J. By this process the inventors are enabled to produce real fur without the pelt or skin of the animal. The process is such that articles of apparel, such as caps, collars, muffs, and the like, of any shape or style, may be made in the manufacture of the fur, and the articles may be made seamless, and fur may be left upon both the inside and outside of the articles, if desired,

Removing Prints from their Mounts.

It is by no means an unusual circumstance that, for some reason or other, it becomes necessary to remove a photograph from its mount. Possibly it is mounted on the page of an album, and it may be desired to frame it or transfer it to another; or, on the contrary, it may be framed, and it is desirable to place it in an album; or, again, the style of frame and mount is not in accord with others with which it is to hang, or, what is by no means improbable, the print has faded, and it becomes necessary to replace it with a fresh one, retaining the original mount, which may bear an autograph that it is important to preserve.

Now, the removal of a print from its mount—as, no doubt, many from experience are aware—frequently proves to be by no means such a simple operation as at first sight it may appear, and the attempt often leads to the destruction of a valuable picture, or—what in some cases is an equal misfortune—the original mount is injured to such an extent that it becomes worthless.

If we could always ascertain the mountant employed much trouble would be saved, as we should then at once know how to proceed. In the present instance we shall assume that we are entirely ignorant of it. The first thing to do, supposing the print to be framed, is to take it out, and, if it be in a cut-out mount, to remove that. If the print were framed by a photographer, in all probability it would be simply secured to the mount by strips of gum paper; but if by a picture-frame maker or a professional mounter, it will, no doubt, be glued to the mount, in which case, unless care be taken in separating it, the picture may be torn at the edges. The best plan is to gently force it away from the mount by passing the blade of a palette knife round the opening from the inside. After removal the picture is closely examined to see if any clew can be obtained as to the kind of cement with which it is attached. If it be "rough mounted," probably some of it may have exuded from the edges, and then its color may serve as a guide; for if it be dark in color it is no doubt either glue or dextrine, and if the former it may be detected by wetting it with saliva, when its well known odor will be developed.

India rubber has been so little employed as a mountant that the probability of that having been used is somewhat remote; yet it may have been. In that case, if the picture have been but recently mounted, it may sometimes be removed by raising one corner with the point of a penknife, and then gently peeling it off; or, if the mounting be of an old date, possible the India-rubber may have perished, and then its removal is easy enough. Failing this the picture must be saturated with benzole, and this will soften the rubber and permit of an easy removal. If the mount be of plate paper the benzole is better applied from the back.

We will now suppose that India-rubber was not the mountant employed; therefore the print should be immersed in clean cold water, where it may be allowed to soak for an hour or two, trying it from time to time to see if the mountant has softened at all. If so, a longer immersion will, no doubt, allow of its removal. If, on the contrary, after several hours' soaking the cement show no signs of yielding, the print should be put into warm water for a quarter of an hour or so, when, if the mountant be glue or gelatine, the print and mount will be easily separated.

With this treatment most of those materials that are employed for mounting photographs will have yielded, but there are some kinds of starch which will obstinately resist it—even after many hours' soaking in both hot and cold water. When we get an obstinate case such as this, it is better to abandon the idea of removing the print from the mount, but to reverse the order of procedure and remove the mount from the print. Doubtless, from the prolonged soaking, the mount itself will have shown signs of succumbing, and we, therefore, proceed to separate the sheets of paper of which it is composed (one by one) until we get to the last—that to which the print is attached. It is now removed from the water, placed face downward on a plate of glass, and flooded with warm water. The paper is now abraded and carefully rubbed off, bit by bit, with the finger, and with care and patience it may be entirely removed without injury to the picture.

Supposing the print has been mounted in an album, the treatment above described cannot be applied. We must, therefore, proceed as follows: First get two plates of tin, or pieces of waterproof paper (such as are employed in copying books), somewhat larger than the pages, and several sheets of damp, white blotting-paper a little smaller. Now place several sheets of the latter at the back and front of the leaf carrying the print, inclose the whole between the tin plates, and put them under pressure. The tin plates will effectually protect the other leaves of the album from the moisture. After resting for an hour or two (during which time the blotting-paper must be kept damp), if the print cannot be removed the blotting-paper should be ironed with a hot laundry iron. After this treatment the print can no doubt be easily removed, and any adherent cement cleaned off with a soft sponge and warm water. The leaf is then pressed between several thicknesses of dry blotting-paper; after which sponged both back and front with strong alcohol, and again blotted off. If this treatment be repeated several times the alcohol will remove the greater of the water, and the leaf when dry will not be nearly so much cockled as if it were allowed to dry spontaneously.

It sometimes happens that it is necessary to remove a print which has faded from its mount, and the latter may contain a title or an autograph, which it is impossible to replace. Under these circumstances we proceed in much the same manner as with the album, taking care, however, that the blotting-paper as well as the water with which it is moistened is scrupulously clean, as plate paper is most easily soiled. In an obstinate case, the print being of no value, it may be rubbed off piecemeal, as was recommended for removing the last sheet of paper, when the mount had to be destroyed. After the print has been "coaxed off" the margin of the mount should be thoroughly wetted, and then dried between sheets of blotting-paper, which will keep it flat. In putting prints on mounts that have borne other pictures care should be taken that they are trimmed a trifle larger than the old ones, so that they overlap the space previously occupied.—*Brit. Journal of Photography.*

How to Avoid Dangers in Electric Lighting.

The Boston Manufacturers' Mutual Fire Insurance Company is engaged in making a thorough investigation as to the alleged dangers which may occur from the electric light and other matters connected therewith. The company makes the following observations in a recent preliminary report:

The danger of the arc lamp itself, unless protected above and below, has already been stated, and is easily provided against. The dangers of contact with telegraph, telephone, or electric watch clock wires, are too obvious and well known to call for further warning, and are all readily guarded against in a well organized mill yard.

There is another danger, which may also be easily avoided but of which notice should be taken at once by every member using an electric arc light, or contemplating such use; namely, it appears that, if the wire conveying the current is suddenly fractured while the dynamo-machine is in operation, the voltaic arc is extended while the ends of the wire are separating, through several feet of distance, varying according to the power of the machine; that is to say, if the wire is broken at such a place that one end can fall or separate from the other, the voltaic arc, or what would be called in common speech the electric spark, will follow from one broken end to the other, from one to six feet, according to the power of the current generated.

If in that distance the current should pass through or come in contact with wood or any combustible material, especially loose stock of fibrous material, fire would instantly occur. Such an arc might also and probably would be dangerous to life, if a person were exposed to it.

A fracture of the wire may be occasioned by the breaking of a belt, by the rupture of machinery, by a careless mechanic working in the neighborhood of the wire, and by many other causes which will be obvious to every member.

The greatest care should, therefore, be taken in choosing the position of the wires; and they should never be carried along the underside of the beams and transverse thereto, or in any proximity to belts, shafting or pipes.

The danger of suspended wires, exposed to the action of machinery, will be apparent. We are not yet fully prepared to suggest the true method of placing wires and protecting them, but, having indicated the danger, would ask suggestions from those who have used the electric light, in order to enable us to work out the proper instructions.

It may be suggested that the wires should be carried upon the walls out of reach of contact, and across the mill upon or protected by the beams but insulated therefrom.

In dye houses, bleacheries, print works, paper mills, and other works where wet processes are in use, the greatest care must be taken that the two wires do not come in contact with the same surface of damp or wet wood, as in such case a cross arc may be formed upon the wood; and it appears that, if common salt is in the water, and perhaps other salts, the danger of a cross arc upon the wood is very much increased. Salt being used in whitewash, a damp surface of wood whitened may be most dangerous. By "cross arc" is meant the diversion of the electric current from one wire to another across the damp or wet woodwork.

It is suggested that this danger may be avoided wholly by carrying the wire from the machine to the lamp over a separate beam or surface of wood from that on which the other wire is carried away from the lamp.

It may be added that we have not yet found any cause of danger of fire, from the use of the electric method of lighting, which may not be avoided, if the right method and proper care be used in putting up and operating the apparatus; but electricity is a force which cannot be too carefully controlled, directed, and watched, if generated in currents of considerable intensity.

It will take yet a considerable time to obtain all the necessary information for making a full report upon this important subject, and our final report may not be submitted for some weeks.

We add also one word of caution. Our members should be careful with whom they deal, and be perfectly sure not only of good and safe work, but also of the responsibility of the contracting parties, both with respect to the character of the work and of immunity from loss, in view of the fact that the whole subject may be said to be shingled over with patents.

Medical Fees in London.

I believe that it is now the habit of the principal London physicians to charge three guineas ($15) for a visit at the house of the patient, two guineas ($10) for the first visit of a patient to the physician's office, and one guinea ($5) for a subsequent visit there. After all, a man who is believed to have special talents for healing is right to charge highly for it. The abuse seems to me to be this: whereas any physician may charge more than a guinea, no physician is allowed by the etiquette of the profession to charge less, and yet probably there are many clever young physicians who now have very little practice, and would themselves gain and benefit others, were they allowed to charge half a guinea.—*London Truth.*

Fire-Resisting Construction.

It is a common error to suppose that stone and brick and iron are the only materials capable of resisting fire. The brick arch and cast iron girder system has been found hopelessly defective—in fact positively mischievous, and the only way of rendering iron safe was not discovered till large factories and buildings had been wrecked. Then it was found that the weakness of the system resided in the exposed lower flanges of such girders, and it was not long after the incasing of the ironwork with some refractory material, such as concrete or fireclay, suggested itself. Concurrently with the notion that nothing is safer than iron, is the belief often held that wood is the most destructible of all materials. In reply to those who distrust wooden construction, we may refer to some plans which have been proposed to render wooden flooring resistive of the action of fire, but which appear to have escaped attention.

One of these is to construct solid timber floors, composed of ordinary joists placed close to each other, and spiked or screwed at intervals with bolts. The bolts are fixed alternately. To form a key for the plastering angular grooves are cut under each joist, these grooves forming a series of dovetails. In a similar manner stairs can be formed by a series of joists screwed or spiked together, which are cut to the form of the soffit, the latter being prepared for plastering by grooves. This system of construction was introduced by Messrs. Evans & Swain. With regard to partitions, the French plan of constructing them with quarterings, filled in with rough stone rubble, then lathed on each side with strong laths, and a coat of plaster applied and pressed through the vacuities from each side, ought to be more generally employed. In the construction of roofs the solid system of concrete or of layers of fibrous material covered with earth and sand, as used by some Eastern nations, have undoubted merits over the timber and hollow roof systems used by modern builders, which readily invite fire. Solid concrete flats laid on iron joists, or iron joists fixed to the inclination of the roof, and then filled in with concrete on the French system, covered with Claridge's asphalt, would render our large buildings comparatively safe from the destructive ravages of flames which now find their way through the roof.

Wood and concrete are not so much used together as they might be. In floors, as well as in roofs, the timbers might be filled in with concrete. Mr. Marrable adopted a very simple method of constructing floors. Instead of the wooden joists being cut to the usual rectangular section they were cut diagonally of a wedge-shaped form and placed at about eighteen inches apart, the wide end being placed downward. Upon these concrete was filled in upon a wooden centering, and the joists performed the office of skewbacks for the concrete. Another form of floor, suitable for warehouses, offices, and small dwellings, is composed of wood joists with a lower flange, these flanges being made also of wood rabbeted close together, forming a boarded ceiling in appearance below. This ceiling could be painted. Such a timber floor resists an outbreak of fire for some time, and is very strong. We do not now consider the many excellent, though more costly, systems of flooring of iron and concrete, or iron incased with fireclay or embedded in concrete, such as the Dennett, the Hyatt, and Moreland systems, our object being to show that timber can be used with good effect to resist as well as to court the flames. A solid impermeable surface or floor covered with asphalt has been known to resist the flames for hours, and by imprisoning it the danger of a conflagration is lessened. It is this principle which has given to the concrete floors their invulnerable character. The value of doors of concrete, such as those erected by Mr. Lascelles, and wrought iron sliding doors, are great, and for security against the extension of fire surpass the sheet iron doors provided by the Building Act.—*Building News.*

Tractive Force upon Macadamized Roads.

Some interesting experiments have been made at Salem, Mass., to ascertain the tractive force requisite to move street cars and vehicles on a macadamized road. The apparatus used consisted of an inclined plane, at the upper end of which was an iron wheel, over which passed a rope. A loaded box car, weighing, with its contents, 12,830 lb., was drawn up the grade by a weight of 970 lb. suspended at the other end of the rope. The empty car, weighing 4,820 lb., was drawn up the same grade by a weight of 283 lb. A smaller box car weighing when empty 2,730 lb., was occupied by fourteen persons, and drawn up by 339 lb., and when unoccupied by 176 lb. An ordinary load of sand on a macadamized road was started by 514 lb., and an empty hack, weighing 1,550 lb. by 196 lb. The same hack, with four passengers inside, required 280 lb. to move it. On a level road the load of sand was started by 240 lb., while the large box car yielded to 56 lb. These experiments were made by a horse railroad company to prove that their work was not unusually severe for the horses, and the result was declared to have been altogether satisfactory.

The Art of Seeing Stereoscopic Pictures Without a Stereoscope.

In order to describe in what manner any individual possessing eyes in fair condition may be able to bring both pictures of a stereoscopic card into one, it is not at all necessary to go into the somewhat abstruse question of the convergence of the optic axes, which, although necessary if we were discussing binocular vision in the abstract, is not so when giving, as we propose to do, simple directions by which the stereoscopic effect may be seen *without the stereoscope*.

The eyes must, first of all, be tutored, by giving them a somewhat simple lesson to perform. The way by which we have invariably succeeded best in this tuition of the eyes is to make two bold ink marks, such as a cross, at a distance of an inch apart, upon a sheet of white paper, and within a half inch of the upper edge of the sheet. Now, upon a second sheet of paper make another single mark, similar to the two others. We prefer a cross for this purpose, although any other form will answer. Hold this latter sheet about twenty inches from the eyes, which must then be directed to the cross. While this is being done, hold the other paper, with its two marks, about half way between the eyes and the single cross sheet. Upon looking intently at the single or more distant mark the mind will soon become conscious of there now appearing to be *three* crosses upon the nearer sheet. Should they not coalesce immediately, move the paper a little way near to or further from the eyes till they do so.

It is now requisite that the eyes be diverted from the distant mark to the central one of the three that are apparent on the nearer paper, and after a minute's practice this can readily be done. The next step in advance is to practice upon a card having two similar crosses at a much greater distance apart than the former pair; and when these can be with facility brought into one, in doing which it may be necessary to hold them at a greater distance away than in the former case, then may a stereoscopic slide be substituted.

At first it is best to employ a stereoscopic picture specially selected for the purpose—one having a well-defined bold object in the center, such as a tree. Not only so, but it will be advantageous to cut this picture into two halves and remove a piece from the center, so as to bring the objects much closer together than is usually the case; for the nearer the two pictures are together the more easy will it be for the eyes to unite them by the process described. There will be three pictures visible, but the center one, being composed of the other two, will stand out in full stereoscopic relief.

While examining this divided photographic picture upon a table, as soon as the eyes have acquired facility in individualizing every detail in them, the halves may be slowly separated; and if, during this operation, the eyes are fixed upon one point of the scene depicted, a separation to the extent of the distance between the two eyes may be made.

Should there be more difficulty in getting the photographs to combine than was experienced in the case of the two ink crosses let them be treated as in the original experiment; that is to say, hold up the single cross sheet at a distance of thirty or forty inches, and hold up the pictures at eighteen or twenty inches away. Now look at the cross until you realize that the slide which intervenes contains three pictures, and let the eyes be then gently transferred from the contemplation of the cross to the center figure on the stereoscopic slide, which will be in the same line of vision. The stereoscopic effect will now be seen in all its boldness.

After this art has been acquired it will not again be forgotten, and it will afford a high degree of pleasure to its possessor, who, when turning over a quantity of stereoscopic pictures on the table of a friend, or when examining them in the window of a store, can realize their full beauty without requiring to use an instrument.—*Photo. Times.*

The Great Desert of Sahara.

In a paper which Dr. Oscar Lenz contributes to the *Zeitschrift* of the Berlin Geographical Society, he gives an authentic account of the results of his journey across the Sahara, from Tanger to Timbuctoo, and thence to Senegambia. The real journey was begun at Marrakesh, at the northern foot of the Atlas Mountains, where Dr. Lenz laid in his stores of provisions and changed his name and dress, traveling further under the disguise of a Turkish military surgeon. He crossed the Atlas and the Anti-Atlas in a southwestern direction. The Atlas consists, first, of a series of hills belonging to the Tertiary and Cretaceous formations, then of a wide plateau of red sandstone, probably Triassic, and of the chief range which consists of clay-slates with extensive iron ores. The pass of Bibauan is 1,250 meters above the sea level, and it is surrounded with peaks about 4,000 meters high, while the Wad Sus Valley at its foot is but 150 meters above the sea. The Anti-Atlas consists of Palæozoic strata.

On May 5, 1880, Dr. Lenz reached Tenduf, a small town founded some thirty years ago, and promising to acquire great importance as a station for caravans. The northern part of the Sahara is a plateau, 400 meters high, consisting of horizontal Devonian strata, which contain numerous fossils.

On May 15 Dr. Lenz crossed the moving sand dunes of Igidi, a wide tract, where he observed the interesting phenomenon of musical sand, a sound like that of a trumpet being produced by the friction of the small grains of quartz. But amidst these moving dunes it is not uncommon to find some grazing places for camels, as well as flocks of gazelles and antelopes. At El Eglab Dr. Lenz found granite and porphyry, and was fortunate enough to have rain. Thence the character of the desert becomes more varied, the route crossing sometimes sandy and sometimes stony tracts of sand dunes, with several dry river beds running east and west between them.

On May 29 he reached the salt works of Taudeni, and visited the ruins of a very ancient town, where numerous stone implements have been found. Here he crossed a depression of the desert only 145 to 170 meters high, while the remainder of the desert usually reaches as much as 250 to 300 meters above the sea level, and he remarks that throughout his journey he did not meet with depressions below the sea level. The schemes for flooding the Sahara are therefore hopeless and misleading. The landscape remained the same until the wide Alfa fields, which extend north of Arauan. This little town is situated amidst sand dunes devoid of vegetation, owing to the hot southern winds. Four days later Dr. Lenz was in Timbuctoo, whence he proceeded west to St. Louis.

During his forty-three days' travel through the Sahara Dr. Lenz observed that the temperature was not excessive; it usually was from 34° to 36° Celsius, and only in the Igidi region it reached 45°. The wind blew mostly from the northwest, and it was only south of Taudeni that the traveler experienced the hot south winds (*edrash*) of the desert. As to the theory of northeastern trade-winds being the cause of the formation of the desert, Dr. Lenz remarks that he never observed such a wind, nor did his men; it must be stopped by the hilly tracts of the north. Another important remark of Dr. Lenz is what he makes with respect to the frequent description of the Sahara as a sea bed. Of course it was under the sea, but during the Devonian, Cretaceous, and Tertiary periods; as to the sand which covers it now, it has nothing to do with the sea; it is the product of destruction of sandstones by atmospheric agencies. Northern Africa was not always a desert, and the causes of its being so now must be sought for, not in geological, but in meteorological influences.—*Nature.*

A Perfect Apple Tree

BY H. C. HOVEY.

The apple tree has long been a favorite. That ancient botanist, Solomon, mentions it as conspicuous for beauty "among the trees of the wood," and other oriental writers have named it along with the graceful palm and noble citron. Apples have been cultivated on the soil of Great Britain ever since the time of the Roman invasion; and it is said that there are now known to be as many as 2,000 varieties, some of which are successfully grown as far South as New Zealand, while others thrive as far north as the 65th degree of latitude. The fruit is universally appreciated, and each variety has its admirers, from the globular, aromatic pippin, down to the painted Siberian crab. And yet, among all the thousands of trees now growing, how rarely do you see one that is shapely and symmetrical!

The perfect apple tree of which an account is here given is a specimen of the hearty, juicy, old-fashioned Vandeveer pippin. It was selected with care by my father, in 1838, and transplanted to a sunny, sheltered spot, near his home in Crawfordsville, Ind. The virgin forest had just been removed from the fertile soil amid which its roots were placed; and throughout its career it has been plentifully watered by the overflow from two ample roofs.

The law of spiral growth, so often distorted, has been beautifully wrought out in this individual tree. The reader is probably aware that the leaves on every tree follow a definite arrangement on the stem. The plan is highly complex in pines and cedars, but simple in the apple tree. Fasten a thread to a leaf and pass it from one to another, in the same direction, and it will go twice around the stem before reaching a leaf situated exactly above the first. The divergence of the second leaf from the first is 144°, or two-fifths of a circle; there is the same distance between the second and the third, and so on to the sixth, which is directly above the first. This is what is known as the *generating spiral.*

The leaf is the builder of the tree. It hangs out its inch or two of oval green in the air for breath and sunshine, and drinks in the dew and the rain, conveying the result of its vegetable chemistry to a permanent place in the substance of the tree. From the heart of each leaf a cord goes into the fiber of the wood, which is only a binding and knitting together of many leaf cords, and when the leaves shrivel and fall, these cords remain as their monuments. As Ruskin has said, "Behold how fair, how far prolonged in arch and aisle, the avenues of the valleys, the fringes of the hills, the joy of man, the comfort of all living creatures, the glory of the earth, they are but the monuments of those poor leaves that flit faintly past us to die."

It is evident that, unless the orderly procedure of nature be in some way disturbed, each twig, branch, and bough, and the very structure of the trunk itself, should conform to this law of spiral development, the entire fabric being reared after the plan marked out by the first five leaves.

And thus it is, in the fine old tree here held up as an example of what a tree is capable of becoming. All its conditions have favored a symmetrical and uninterrupted development. Hence one can trace the spirals from the ground to the outmost bough, except where they lose themselves by being knotted together.

Five buttressed roots, each one foot in diameter, mark the emergence of the tree from the ground. The circumference of the trunk immediately above them is nine feet; and it is made of five distinct strands, like those of a rope, twisted around each other, until at the height of six feet from the ground, and exactly over each corresponding root, each strand puts forth a branch. The girth of the tree, midway, is eight feet; but just below the whorl of branches it increases to nine again. The branches, five in number and arranged in a spiral, measure at the point of divergence respectively, three feet, three feet and six inches, three feet and eight inches, four feet, and four feet six inches. The height of the entire tree is about forty feet. The diameter of its canopy from north to south is forty-three feet; and from east to west it is forty-five feet.

It should be added that this patriarchal apple tree enjoys a green and fruitful old age; being still a prolific bearer, although it has stood where it now is for forty-four years, and is probably as much as forty-six years old.

Fertilizer Experiments.

In the discussion on fertilizers, at the recent meeting at Newtown, Conn., Mr. Sedgewick, of Cornwall, said he thought that Dr. Atwater's experiments had saved the farmers a great amount of money by teaching fertilizer manufacturers that less nitrogen is required for many crops than had formerly been supposed. Nitrogen is the most costly ingredient used in commercial fertilizers, and the most difficult at the present time to obtain. It would be wasteful, therefore, to use a greater quantity than is really needed, and such waste is exceedingly costly to the farmer. As it is found that less nitrogen is required, the price of fertilizers has been gradually dropping in market, and this gain is greatly to the benefit of the farmer. It enables him to buy more, and to use more with a fair prospect of obtaining a profit. One objection to the use of guano, he believed, was that it contains a larger percentage of nitrogen than is needed, and consequently a larger proportion than farmers can afford to pay for. A saving of one per cent in the amount of nitrogen in a ton of fertilizer will cheapen the cost about four dollars. He thought the most profitable way to use fertilizers is in connection with stable manure, the fertilizers being compounded in such a way as to make the manure and fertilizer together just meet the wants of the crops to be grown. Exactly how the nitrogen is taken by plants, he did not attempt to explain, but it is evident that soil which is well filled with the tops and roots of clover and other plants contains a large amount of nitrogen that the growing crop will in some way appropriate.—*New England Farmer.*

How to Make Peppermint Drops.

Take a convenient quantity of dry granulated sugar; place it in a pan having a lip from which the contents may be poured or dropped; add a very little water, just enough to make the sugar a stiff paste, two ounces of water to a pound of sugar being about the right proportion; set it over the fire and allow it to nearly boil, keeping it continually stirred; it must not actually come to a full boil, but must be removed from the fire just as the bubbles denoting the boiling point is reached begin to rise. Allow the sirup to cool a little, stirring all the time; add strong essence of peppermint to suit the taste, and drop on tins, or sheets of smooth white paper. The dropping is performed by tilting the vessel slightly, so that the contents will slowly run out, and with a small piece of stiff wire the drops may be stroked off on to the tins or paper. They should then be kept in a warm place for a few hours to dry. If desired, a little red coloring may be added just previous to dropping, or a portion may be dropped in a plain white form, and the remainder colored.

There is no reason why peppermint should alone be used with this form of candy, but confectioners usually confine themselves to this flavor. Any flavor may be added, and a great variety of palatable sweets made in the same manner. If desired, these drops may be acidulated by the use of a little tartaric acid and flavored with lemon, pineapple, or banana. In the season of fruits, delicious drops may be made by substituting the juice of fresh fruits, as strawberry, raspberry, etc., for the water, and otherwise proceeding as directed.—*Confectioner and Baker.*

Effect of Electric Lighting on the Demand for Gas.

The *Journal of Gas Lighting*, in a review of the past year, says: "Perhaps the most positive and abiding result of the rage for electric lighting in public streets is the increase of gas consumption which inevitably follows the removal of the electric lamps, or is insisted upon in districts adjacent to those occupied by the electricians. The old style of street lighting, with five foot burners, or even worse, will no longer satisfy the public in busy thoroughfares. More light is demanded even from gas, and there is consequently a large and growing use for high-power gas burners. It is fortunate for the interests of gas lighting that the opportunity has not been allowed to pass fruitlessly by the manufacturers of gas lamps. Numerous inventors, such as Herr Frederick Siemens, Messrs. Sugg, Bray, Wigham, and, latest of all, Mr. Douglass, have demonstrated that the modern demand for better means of lighting is capable of being amply satisfied by ordinary coal gas alone. Whether electric lighting eventually succeeds in establishing itself or not, it is certain that it has given a great impetus to the business of gas lighting in the past year.

a title or an autograph, which it is impossible to replace. | subsequent visit there. After all, a man who is believed to declared to have been altogether satisfactory.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

ATLANTA, GA., Dec. 24, 1881.
H. W. Johns M'f'g Co., 87 Maiden Lane, New York:
DEAR SIR: . . . The warehouse (300 x 300) in Columbus, Ga., was covered with your roofing, ordered by Col. W. L. Salisbury, some ten years ago, and it is now apparently as good as new. Yours truly,
J. T. WARNOCK, M.D.

Granville Hydraulic Elevator Co., 1193 B'way, N. Y.

Will Manufacturers of Baking Powder Tins send their address to Am. Chemical Co., Box 348, Pittsburg, Pa.

To Stop Leaks in Boiler Tubes, use Quinn's Pat. Ferrules. Address S. M. Co., So. Newmarket, N. H.

The Universal Calculator.—A novel labor-saving machine for solving questions in arithmetic and mensuration without mental labor. The most tedious problems solved in less than half a minute. Invaluable to engineers, mechanics, and business men. Sent free for $1. Send for circular. Address W. H. Wythe, Red Bank, N.J.

Wanted.—A Scientific Inventor to improve a secured Patent Imitation Ostrich Feather. A fortune for the right party. Address, in real name, "Feather," Box 773, New York.

The Berryman Feed Water Heater and Purifier and Feed Pump. I. B. Davis' Patent. See illus. adv., p. 44.

Light and Fine Machinery and Tools to Order. Lathe catalogue for stamp. E. O. Chase, Newark, N. J.

For Machinists and Apprentices.—The Student's Illustrated Guide to Practical Draughting. Sent on receipt of $1. T.P.Pemberton, 142 Greenwich St. P.O.Box 3083,N.Y.

Chemist's Pocket Book.—For Chemical Manufacturers, Metallurgists, Dyers, Distillers, Brewers, Sugar Refiners, Photographers, etc. By Thomas Bayley. $2, mail free. E. & F. N. Spon, 446 Broome St., New York.

Patent Wanted.—I want to buy whole or part interest, or manufacture on royalty. Address H. C. Lyon, New York.

Manufacturers, Steam Boiler Owners, Towns and Cities desiring pure water, send for circular to the Newark Filtering Co., Newark, N. J.

For Sale Cheap—6 Lathes, 28 Engines, 4 Bolt Cutters, 1 Fowler Press. All on hand. York & Smith, Clevel'd, O.

Malleable and Gray Iron Castings to order, by Capital City Malleable Iron Co., Albany, N. Y.

For Power & Economy, Alcott's Turbine, Mt.Holly, N. J.

Combination Roll and Rubber Co., 27 Barclay St., N. Y. Wringer Rolls and Moulded Goods Specialties.

Lightning Screw Plates and Labor-saving Tools, p. 30.

Send for Pamphlet of Compilation of Tests of Turbine Water Wheels. Barber, Keiser & Co., Allentown, Pa.

List of Machinists in United States and Canada, just compiled; price, $10. A. C. Farley & Co., Philadelphia.

Presses & Dies (fruit cans) Ayar Mach.Wks., Salem,N.J.

Latest Improved Diamond Drills. Send for circular to M. C. Bullock, 80 to 88 Market St., Chicago, Ill.

Wood Working Machinery of Improved Design and Workmanship. Cordesman, Egan & Co., Cincinnati, O.

Abbe Bolt Forging Machines and Palmer Power Hammers a specialty. S. C. Forsaith & Co., Manchester, N. H.

"How to Keep Boilers Clean," and other valuable information for steam users and engineers. Book of sixty-four pages, published by Jas. F. Hotchkiss, 84 John St., New York, mailed free to any address.

Supplement Catalogue.—Persons in pursuit of information on any special engineering, mechanical, or scientific subject, can have catalogue of contents of the SCIENTIFIC AMERICAN SUPPLEMENT sent to them free. The SUPPLEMENT contains lengthy articles embracing the whole range of engineering, mechanics, and physical science. Address Munn & Co., Publishers, New York.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Malleable and Gray Iron Castings, all descriptions, by Erie Malleable Iron Company, limited, Erie, Pa.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N. J.

Corrugated Wrought Iron for Tires on Traction Engines, etc. Sole mfrs., H. Lloyd, Son & Co., Pittsb'g, Pa.

Presses, Dies, Tools for working Sheet Metals, etc. Fruit and other Can Tools. E. W. Bliss, Brooklyn, N. Y.

Cope & Maxwell M'f'g Co.'s Pump adv., page 45.

Saw Mill Machinery. Stearns Mfg. Co. See p. 29.

List 27.—Description of 3,000 new and second-hand Machines, now ready for distribution. Send stamp for same. S.C.Forsaith & Co.,Manchester,N.H., and N.Y.city.

Supplee Steam Engine. See adv. p. 30.

Peck's Patent Drop Press. See adv., page 30.

For Pat. Safety Elevators, Hoisting Engines, Friction Clutch Pulleys, Cut-off Coupling, see Frisbie's ad. p. 45.

Safety Boilers. See Harrison Boiler Works adv., p. 44.

Mineral Lands Prospected, Artesian Wells Bored, by Pa. Diamond Drill Co. Box 423, Pottsville, Pa. See p.45.

Improved Skinner Portable Engines. Erie, Pa.

For best Portable Forges and Blacksmiths' Hand Blowers, address Buffalo Forge Co., Buffalo, N. Y.

The Brown Automatic Cut-off Engine; unexcelled for workmanship, economy, and durability. Write for information. C. H. Brown & Co., Fitchburg, Mass.

Ball's Variable Cut-off Engine. See adv., page 60.

Paragon School Desk Extension Slides. See adv. p. 61.

Fire Brick, Tile, and Clay Retorts, all shapes. Borgner & O'Brien, M'f'rs, 23d St., above Race, Phila., Pa.

Brass & Copper in sheets, wire & blanks. See ad. p. 61.

Clark & Heald Machine Co. See adv., p. 62.

The Chester Steel Castings Co., office 407 Library St., Philadelphia, Pa., can prove by 15,000 Crank Shafts, and 10,000 Gear Wheels, now in use, the superiority of their Castings over all others. Circular and price list free.

Millstone Dressing Diamonds. Simple, effective, and durable. J. Dickinson, 64 Nassau street, New York.

The Improved Hydraulic Jacks, Punches, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Ajax Metals for Locomotive Boxes, Journal Bearings, etc. Sold in ingots or castings. See adv., p. 61.

Geiser's Patent Grain Thrasher, Peerless, Portable, and Traction Engine. Geiser Mfg. Co., Waynesboro, Pa.

Tight and Slack Barrel machinery a specialty. John Greenwood & Co., Rochester, N. Y. See illus. adv. p. 60.

For the manufacture of metallic shells, cups, ferrules, blanks, and any and all kinds of small press and stamped work in copper, brass, zinc, iron, or tin, address C. J. Godfrey & Son, Union City, Conn. The manufacture of small wares, notions, and novelties in the above line, a specialty. See advertisement on page 62.

For Walrus Leather, Bull Neck Emery, Glue, Crocus, and Composition, write Greene, Tweed & Co., N. Y.

Magic Lanterns and Stereopticons of all kinds and prices. Views illustrating every subject for public exhibitions, Sunday schools, colleges, and home entertainment. 116 page illustrated catalogue free. McAllister, Manufacturing Optician, 49 Nassau St., New York.

Draughtsman's Sensitive Paper.T.H.McCollin,Phila.,Pa.

For Mill Mach'y & Mill Furnishing, see illus. adv. p. 60.

New Economizer Portable Engine. See illus. adv. p. 62.

Renshaw's Ratchet for Square and Taper Shank Drills. The Pratt & Whitney Co., Hartford, Conn.

For Shafts, Pulleys, or Hangers, call and see stock kept at 79 Liberty St., N. Y. Wm. Sellers & Co.

Wm. Sellers & Co., Phila., have introduced a new injector, worked by a single motion of a lever.

Common Sense Dry Kiln. Adapted to drying of all material where kiln, etc., drying houses are used. See p. 62.

The Porter-Allen High Speed Steam Engine. Southwork Foundry & Mach. Co.,430 Washington Ave.,Phila.P.

Skinner's Chuck. Universal, and Eccentric. See p. 61.

For Rubber Packing, Soap Stone Packing, Empire Packing, and all kinds, write Greene, Tweed & Co., N.Y.

Don't buy a Steam Pump until you have written Valley Machine Co., Easthampton, Mass.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

Correspondents sending samples of minerals, etc., for examination, should be careful to distinctly mark or label their specimens so as to avoid error in their identification.

(1) J. L. asks: Is there a composition which, when applied to the ends of soft wood, will fill up the pores and leave a soft rubber-like surface? A. Try the following: Fuse together over a water bath and mix together equal parts of glue size and good glycerine. Continue the heating for several hours, and use hot. Almost any of the ordinary pigments may be used with this preparation to give color.

(2) M. T. asks: Will you please describe a simple or inexpensive method of producing chlorine in gas or liquid form for bleaching purposes? A. Chlorine may be prepared economically by heating in a stoneware or glass retort a mixture composed of common salt, 10 parts (by weight); manganese dioxide (black oxide), 8 parts; sulphuric acid, 24 parts; water, 12 parts. When this gas is passed through cold water, the water dissolves a considerable portion of it, and the solution (chlorine water) may be employed instead of the gas for bleaching purposes.

(3) G. W. K. asks: 1. Is there not a rule by which I can calculate the centrifugal force of governor balls when number of revolutions per minute and diameter of circle described by center of balls and weight of balls is known? A. Yes, you will find rules for governors in many works on the steam engine: "Haswell's Pocket Book," and "Templeton's Engineer's Common place Book." 2. With a common plain slide valve, and pressure in boiler at eighty pounds, how many pounds would it probably require to be applied to valve connecting rod for each square inch of valve surface? A. About one-fourth the unbalanced pressure.

(4) E. E. B. asks: How can I cure tobacco for chewing after it has dried? It was taken from the stalk about three months ago and hung in a barn tied up in hanks of about a quarter of a pound each. A. You will find this information in SUPPLEMENTS, Nos. 183 and 196. 2. I have a telephone running from house to shop, a distance of about 50 feet. I use very fine brass wire; the diaphragms are of tin type, and common wooden mouthpieces. It goes very well when the wire is wet, but when it is dry it rings, so that it is hard to understand. Will you tell me how to remedy it? A. Use a finer wire cable cord for your telephone.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

A. B. C., P. M.—It is a common variety of fossiliferous clay slate. Usually found in or near the coal measures.

COMMUNICATION RECEIVED.

On the Protection of Electric Light Wires. By W. C.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

January 10, 1882.

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1866, will be furnished from this office for 25 cents. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city. We also furnish copies of patents granted prior to 1866; but at increased cost, as the specifications not being printed, must be copied by hand.

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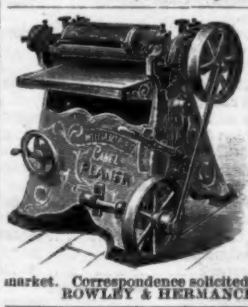
Advertisements.

Inside Page, each insertion - - - 75 cents a line.
Back Page, each insertion - - - $1.00 a line.
(About eight words to a line.)
Engravings may head advertisements at the same rate per line, by measurement, as the letter press. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

PATENTEES.
A Mechanical Engineer, of long experience and first-class connections for the introduction or negotiating new inventions, who leaves in March (to be gone four months) for *England, France, Belgium, Germany, Austria, Italy,* and *Spain,* is open to represent another first-class labor-saving invention or to attend to any business pertaining to patented inventions. Satisfactory references, etc.
DANL. MILLS, 1024 Thompson St., Philadelphia, Pa.


WILLIAMSPORT Pony or Panel Planer. For general use in Door Shops, Box and Furniture Manufactories. For planing Door Panels, Cigar Box Stuff, and Furniture work, it has no equal.
We use the Ellis Patent three part Journal Box and a solid forged steel head. Two pressure bars. Has strong feed. Will plane from 1-16 to 6 inch thick. Weight, 1,400 lb. The lowest priced first-class planer in the market. Correspondence solicited.
BOWLEY & HERMANCE, Williamsport, Pa.

NEEDED, as coalescent inventor, first expense payer, etc., a suitable person. Address Charles Leiser, Hynemansville, Pa.

THE WALLACE DIAMOND CARBONS,
Telegraph, Telephone, and Electric Light Supplies.


THE ELECTRICAL SUPPLY CO., 109 Liberty St., New York.

Owners and Engineers of Scaly Boilers may find a perfect remedy by sending size and number of the same, with address, to AM. CHEM. CO., Box 348, Pittsburg, Pa.


BARNES'
Patent Foot and Steam Power Machinery. Complete outfits for Actual Workshop Business. Lathes for Wood or Metal. Circular Saws, Scroll Saws, Formers, Mortisers, Tenoners, etc., etc. Machines on trial if desired. Descriptive Catalogue and Price List Free.
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No. 1999 Main St.

The Saxon Importing Co., agrees to send by express to any of our readers an extra fine full Nickel Plated 7 shot, 22 calibre, 5 3-4 in. long Revolver upon SENDING THEM the following CERTIFICATE and $1.00 to pay expenses of advertising and packing; or send them $1.00 and 6 three cent stamps (18c.) and they will send it by mail post-paid. To be fancy engraved, it will cost 25 cents extra. Remember this Revolver will not be furnished at above price unless accompanied by this Certificate.
This Advertisement Will Not Appear Again.
CERTIFICATE.—Saxon Importing Co., enclosed find amount as above required to pay for an extra fine Nickel Plated 7 Shot, 22 calibre, 5 3-4 in. long Revolver, and I agree upon receipt of said Revolver to show it and your Catalogues to my friends. Address,
SAXON IMPORTING CO., 116 Chambers St., New York.

PAYNE'S AUTOMATIC ENGINES.


Spark Arrester.
Reliable, durable, and economical, *will furnish a horse power with one-third less fuel and water than any other engine built* not fitted with an automatic cut-off. Send for Illustrated Catalogue "A" 2, for information and prices.
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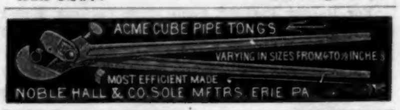

NOTICE TO CONTRACTORS.

SEALED PROPOSALS

For the Grading, Masonry, and Bridging of the extension of the Hartford and Connecticut Valley Railroad (twenty-four miles in length), as a whole, or in sections, will be received at the office of said Company until 12 o'clock M.,

Tuesday, February 14th, 1882.

Plans, Profiles, and Specifications can be examined, and blank forms for proposals will be furnished at the Engineer's Office, corner of Kilbourn and Commerce streets, Hartford, Conn., on and after February 7th, 1882.
The Railroad Company reserves the right to reject any or all propositions that are not for the interest of the Company.
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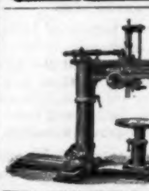
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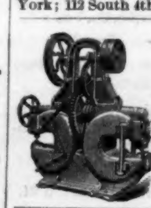
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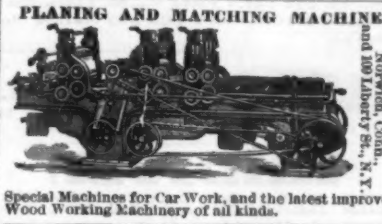

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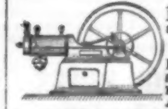

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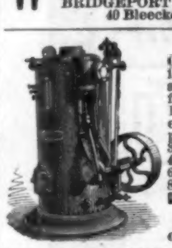

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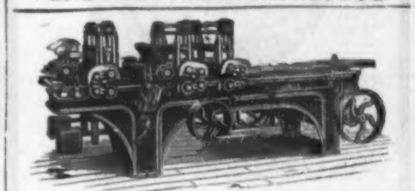

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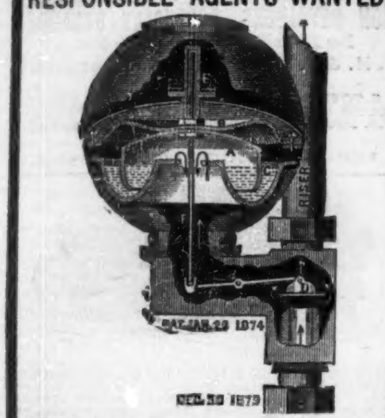

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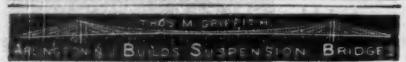

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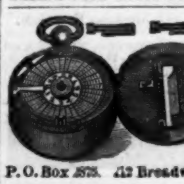

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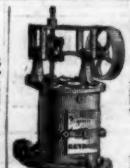

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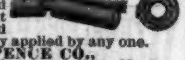

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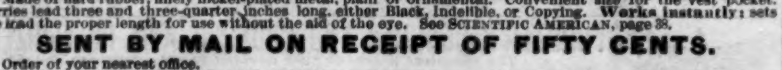

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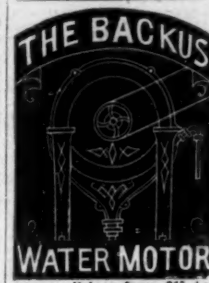

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